Welcome!

Webinar #1: ASSEMBLIES in THERMOFLEX 13 JUNE 2017

Agenda:

* Introduction
* HRSG Assembly
* Boiler Assembly
* Steam Turbine Assembly
* Plant Assembly
* Q & A Session

Presenter: IGNACIO MARTIN (SPAIN)
Support: Meritt Elmasri (U.S. HQ)

Thermoflow

1. Introduction

- Welcome and purpose of the FAW. TF Education options
- Thermoflow Background
- Programs: Application Specific vs Fully Flexible Approach
- Assemblies in THERMOFLEX/PEACE: Why

Thermoflow

Thermoflow Training and Support

- Standard Training
- On-site Training course
- Advanced Workshop
- Webinars when new Version is released
- Help, Tutorials, PPT, Videos
- Technical Support

→ **Feature Awareness Webinars**

Thermoflow Background

- Consulting company 1981-1987 while founder was professor at MIT.

- Since 1987, full-time focus on power plant modeling software. First copy of GT PRO sold in 1988.

- Thermoflow provides the world's most complete and mature heat balance software product line, with over 330,000 man-hours of advanced talent invested during 28 years of steady evolution.

- We believe that the Thermoflow heat balance software suite is the most widely used in the world.

- Developed and maintained by a stable group of experienced mechanical engineers, mostly top MIT graduates and Ph.D.'s, no 'programmers' or external subcontractors ever used.

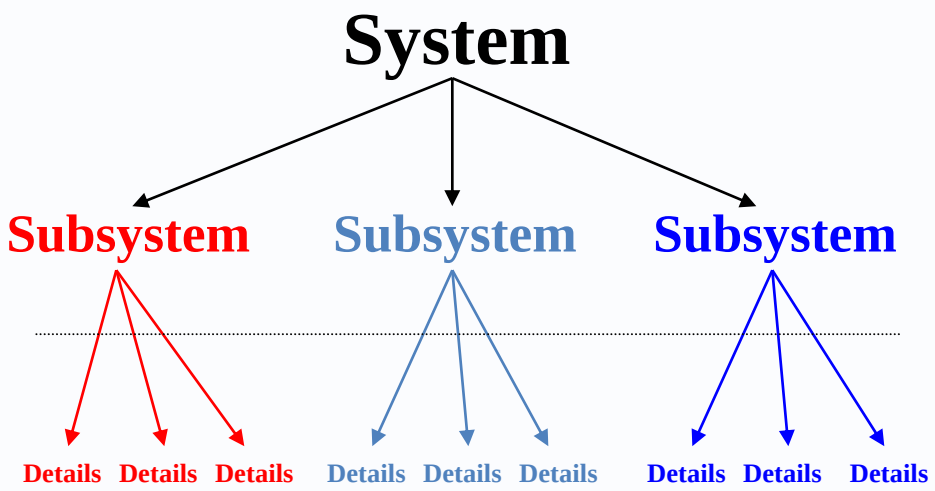
- Thermoflow has always been independent, stable, profitable and conservative. Ample financial resources for stability, derived from excellence of its products, not from sponsors.

Thermoflow

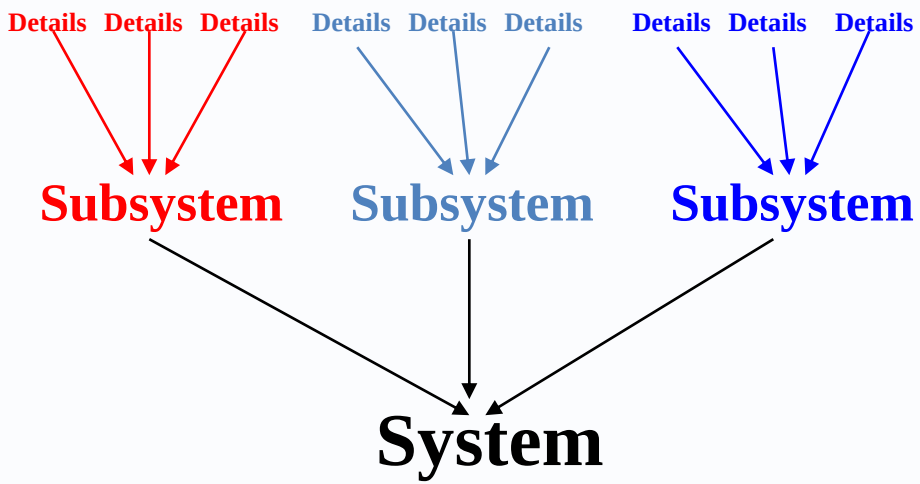
Thermoflow Programs

Program	Year First Copy Licensed	Aprx Total Licenses/Seats Sold (end 2015)
GT PRO	1988	2400
GT MASTER	1988	1840
STEAM PRO	1990	1020
STEAM MASTER	1991	850
RE-MASTER	1992	400
THERMOFLEX	1995	1370
PDE	1995	800
PEACE	1998	1640

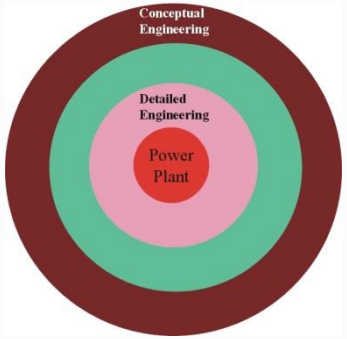
...built from the outside in



...built from the inside out

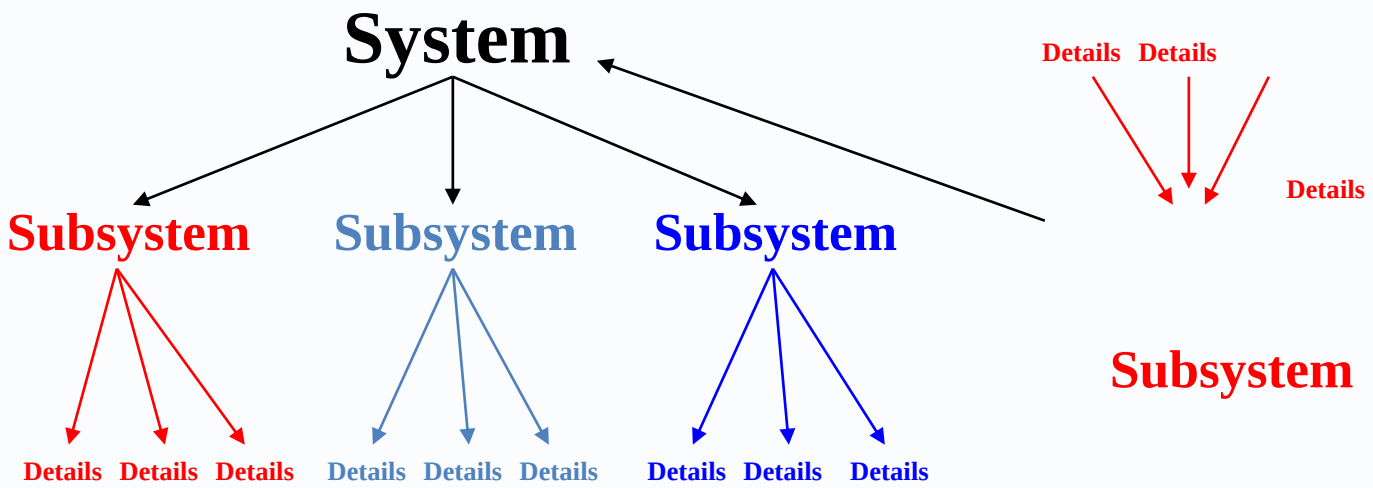


Application-Specific Program



Fully-Flexible Program

...you can even get the best of both worlds



Application-Specific + Fully-Flexible

Plant Design Expert (PDE)
- Executive level of GT PRO

GT Template
- User-Defined GT

GT PRO

-Design of Gas Turbine Combined Cycle and Cogeneration Systems

GT MASTER

- Simulation
- OFF-Design

PEACE*

-Preliminary Engineering
-Cost Estimation
-Detailed Hardware Specifications

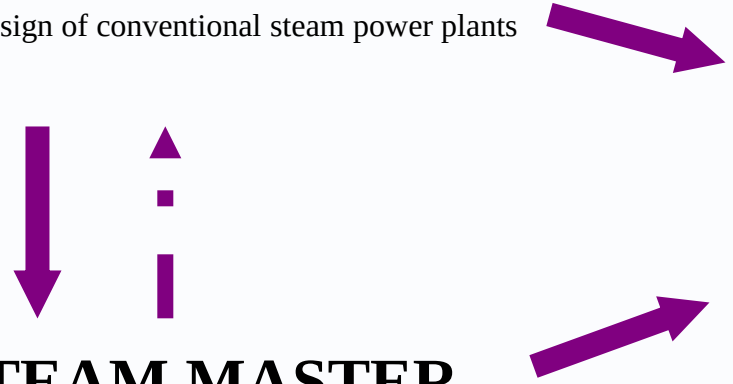
* Plant Engineering and Construction Estimator

Elink
DRS
TOPS

Thermoflow

STEAM PRO

- Design of conventional steam power plants



PEACE*

-Preliminary Engineering
-Cost Estimation
-Detailed Hardware Specifications

* Plant Engineering and Construction Estimator

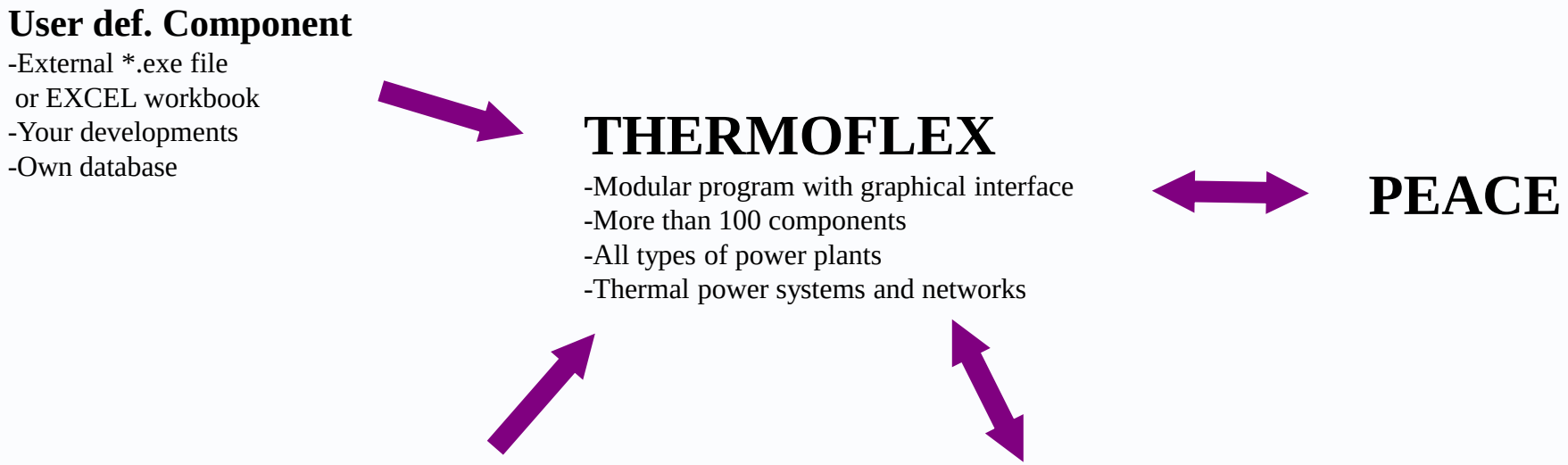
STEAM MASTER

- Simulation
- OFF-Design

RE-MASTER

- Design and Simulation of conventional Steam power plants with gas turbines

Elink
DRS
TOPS



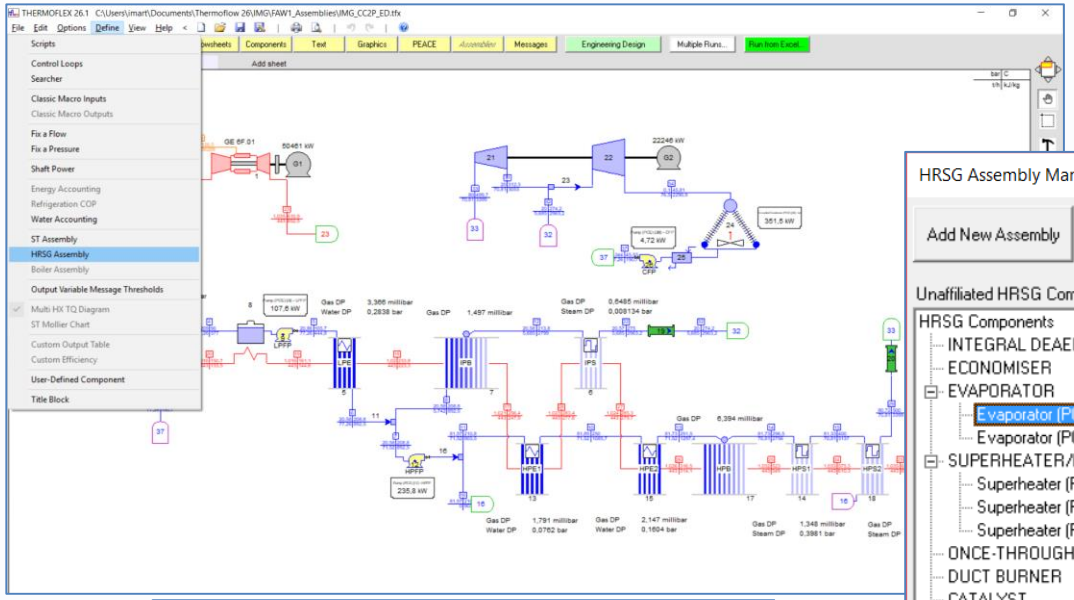
Elink
DRS
TOPS

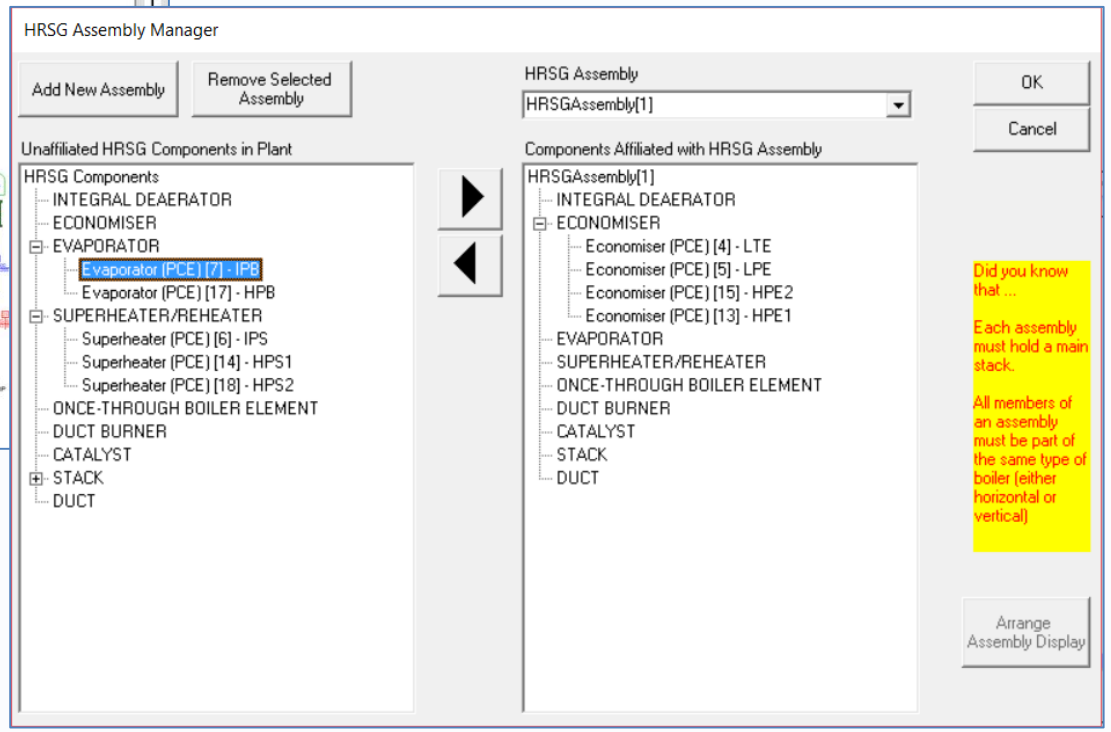
Thermoflow

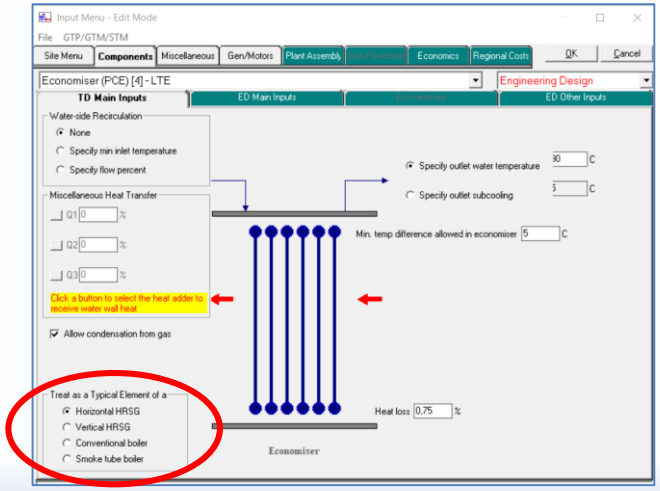
2. HRSG Assembly

- HRSG Design in TFX. TD and ED
- HRSG Assembly Definition and Requisites
- HRSG Assembly Outputs
- Managing the HRSG Assembly
- HRSG Assembly in OD Mode
- HRSG Assembly in files imported from GTP-GTM

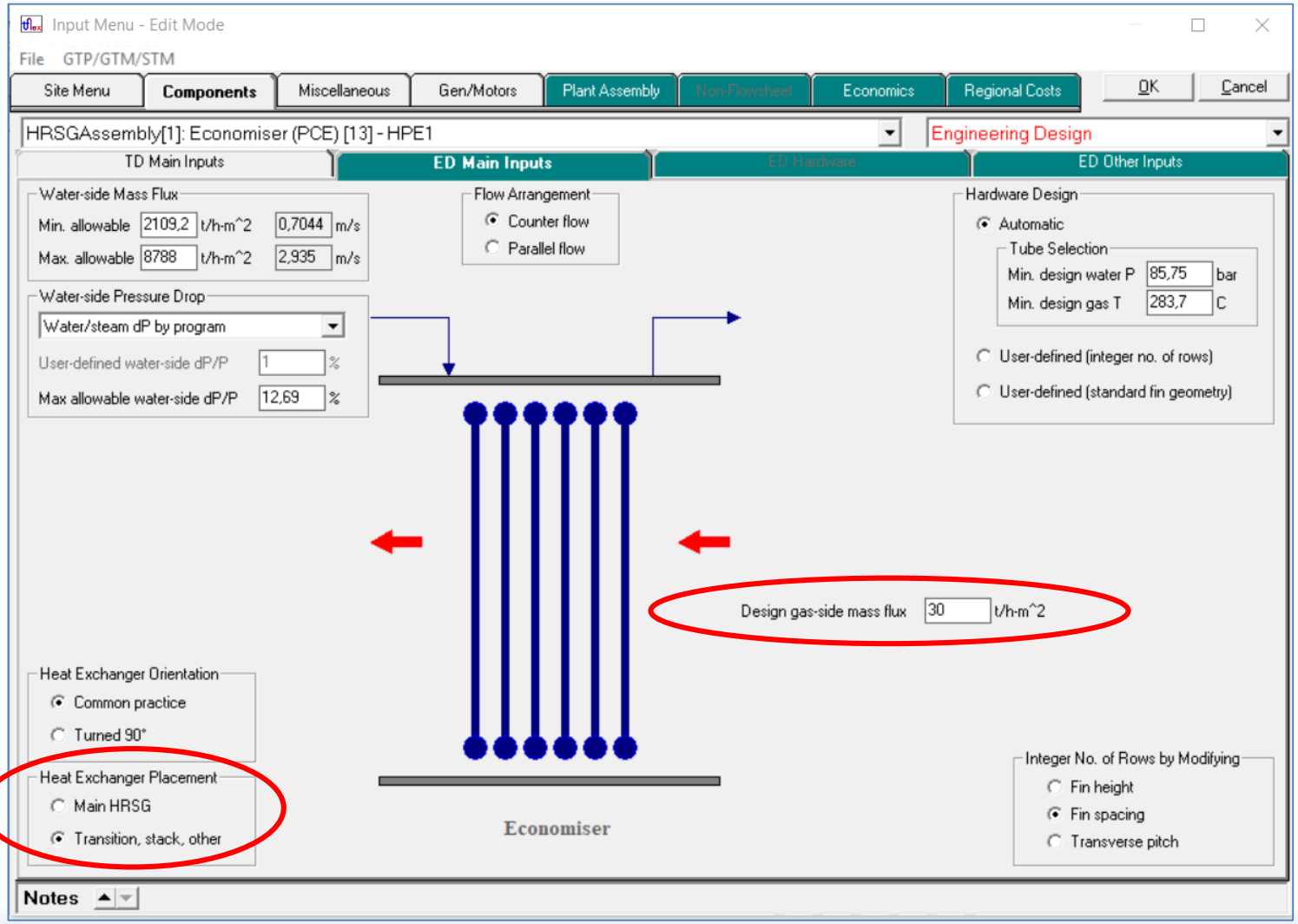
2. HRSG Assembly: Definition and Requisites



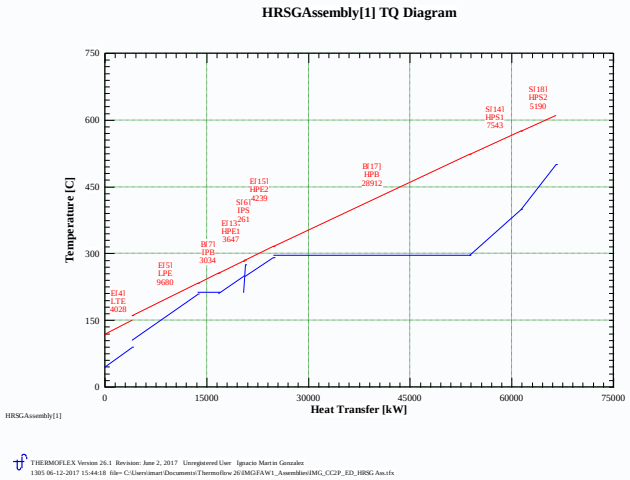


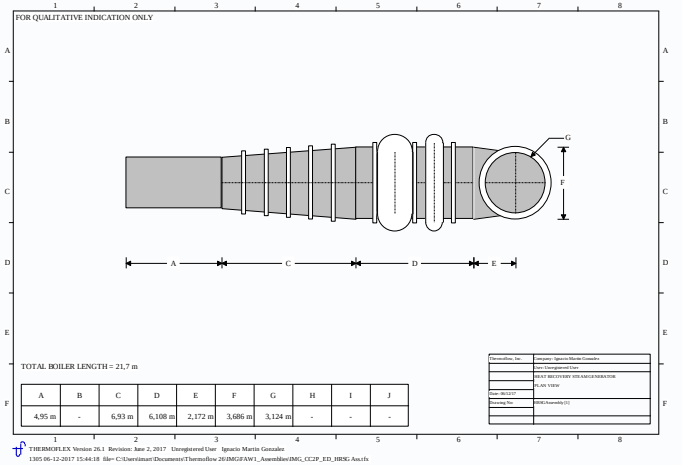


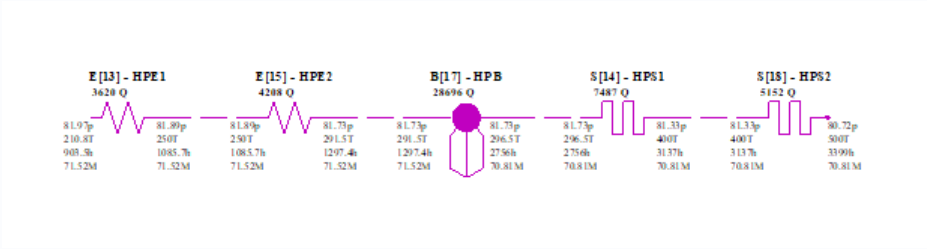
2. HRSG Assembly: Definition and Requisites

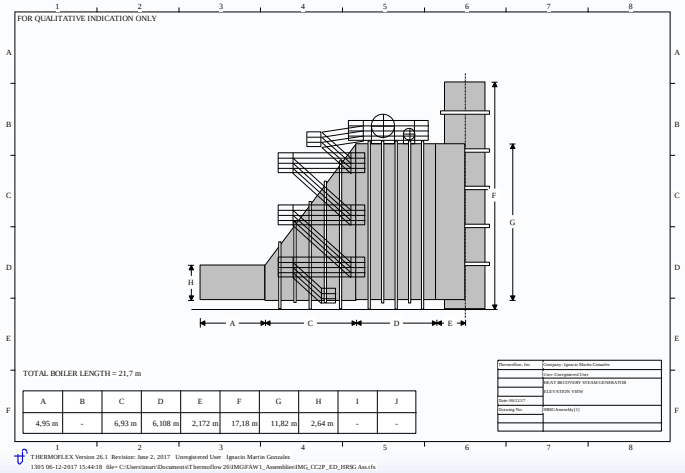


2. HRSG Assembly: Outputs









2. HRSG Assembly: Outputs

HRSGAssembly[1]

File Edit

HRSGAssembly[1]

HRSGAssembly[1]
- Specification
- Overall
- Thermodynamics
- Hardware
- Heat Transfer
- Plan View
- Elevation View
- TQ Diagram
- Water Paths
  - Water Path 1
  - Water Path 2
  - Water Path 3
  - Water Path 4
  - Water Path 5

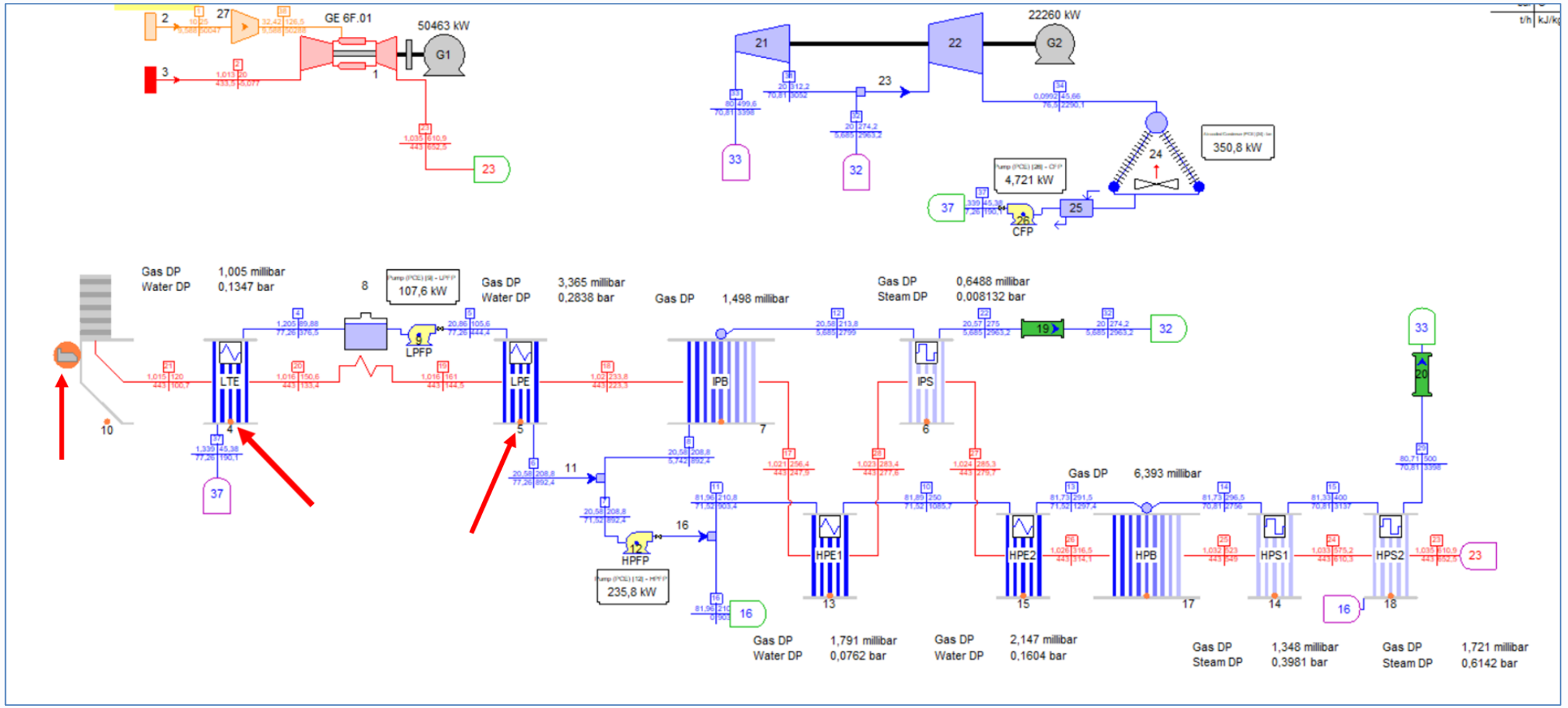
HRSGAssembly[1]	B[17] - HPB	E[15] - HPE2	S[6] - IPS	E[13] - HPE1	B[7] - IPB	E[5] - LPE	E[4] - LTE
Estimated Heat Exchanger Hardware Data							
Tube material	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	T409
Number of tube rows (longitudinal)	12	6	2	3	4	10	3
Number of tubes per row (transverse)	44	44	58	44	40	44	44
Number of rows per waterside flow pass	12	1	1	1	4	1	1
Longitudinal row pitch [mm]	92,52	92,52	69,85	92,52	104,1	92,52	92,52
Gas path transverse width [m]	3,413	3,413	3,413	3,413	3,413	3,413	3,413
Tube length [m]	9,847	9,847	9,847	9,847	9,847	9,847	9,847
Tube outer diameter [mm]	38,1	31,75	37,73	31,75	38,1	31,75	31,75
Tube wall thickness [mm]	2,108	1,905	2,108	1,905	2,108	1,905	3,048
Transverse tube pitch [mm]	76,7	76,7	58,34	76,7	84,27	76,7	76,7
Tube metal conductivity @ 500F (260C) [W/m-C]	46,73	46,73	46,73	46,73	46,73	46,73	26,13
Tube metal conductivity slope [W/m-C^2]	-0,0249	-0,0249	-0,0249	-0,0249	-0,0249	-0,0249	0,0075
Fins							
Fin material	Carbon Steel	Carbon Steel	N/A	Carbon Steel	Carbon Steel	Carbon Steel	T409
Fin height [mm]	12,7	15,88	N/A	15,88	15,88	15,88	15,88
Fin spacing [mm]	3,776	4,059	N/A	2,06	3,737	3,145	2,652
Fin thickness [mm]	0,9906	0,9906	N/A	0,9906	0,9906	0,9906	0,9906
Number of fins per meter	209,8	198	N/A	327,8	211,5	241,8	274,5
Serrated fin segment width [mm]	3,97	3,97	N/A	3,97	3,97	3,97	3,97
Number of serrated fin segments	34,17	30,15	N/A	30,15	35,17	30,15	30,15
Un-serrated height / fin height	0,2	0,2	N/A	0,2	0,2	0,2	0,2
Fin metal conductivity @ 500F (260C) [W/m-C]	46,73	46,73	N/A	46,73	46,73	46,73	26,13
Fin metal conductivity slope [W/m-C^2]	-0,0249	-0,0249	N/A	-0,0249	-0,0249	-0,0249	0,0075
Overall Data							
Gas path frontal area [m^2]	33,61	33,61	33,61	33,61	33,61	33,61	33,61
Min. gas free flow cross section / frontal area	0,4295	0,4991	0,3503	0,4465	0,4631	0,4814	0,4681
H.T. surface area / min. free flow cross section	29,46	25,67	5,75	45,62	31,27	31,91	36,89

2. HRSG Assembly: Outputs

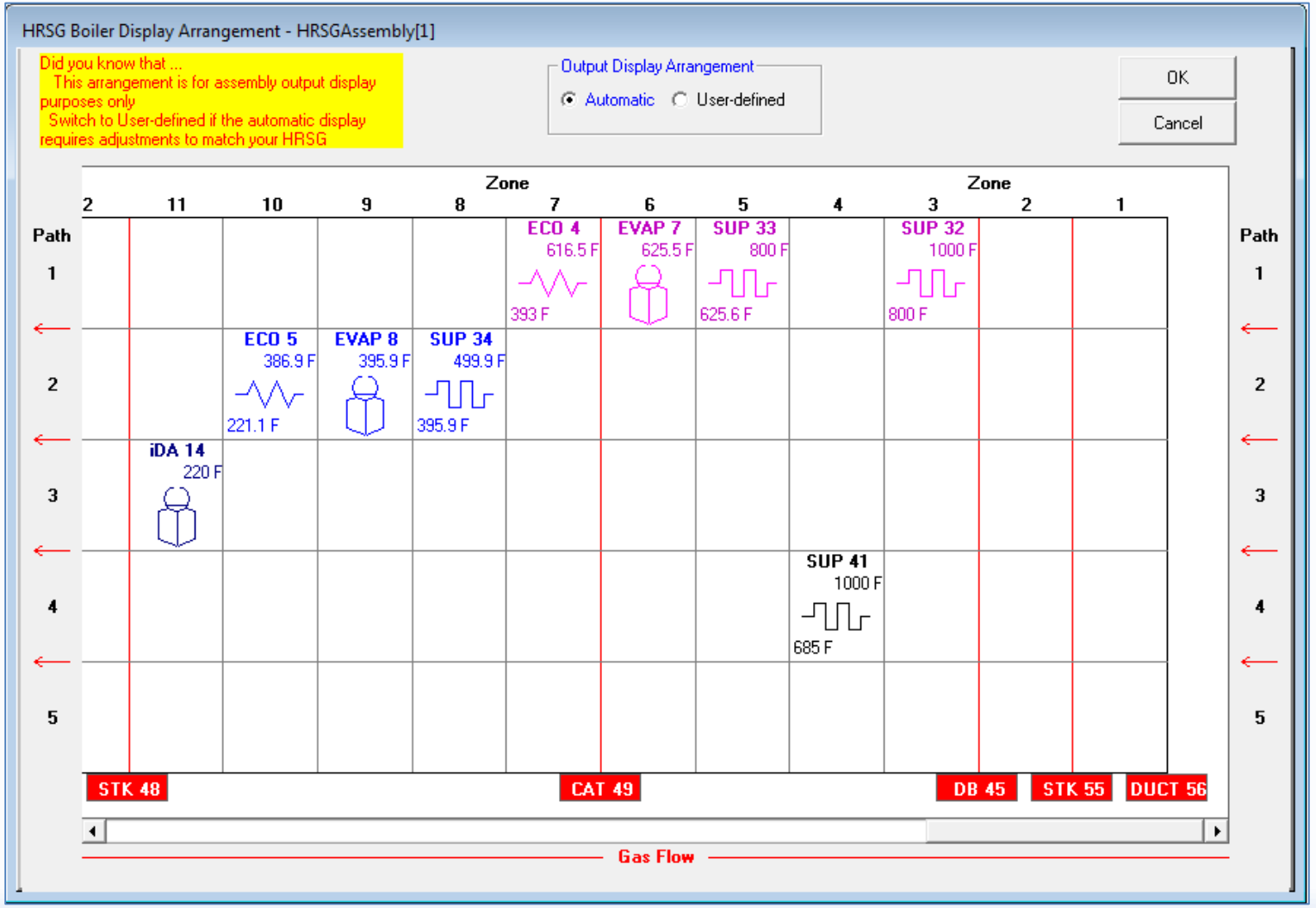
HRSGAssembly[1]		
Estimated HRSG Data		
1. HRSG System Summary		
Size		
Overall Length (horizontal)	21,72	m
Overall Width	3,686	m
Overall Height (HRSG)	11,82	m
Overall Height (Main stack height)	17,18	m
Weight		
Overall Weight (dry)	220.400	kg
Round to Square	7.400	kg
Transition Duct	25.150	kg
Main HRSG Section	187.850	kg
Overall Weight (wet)	234.650	kg
Heat Transfer Surface Area		
Overall surface area	20309	m^2
Economiser	11542	m^2
Evaporator	7051	m^2
Superheater	1716	m^2
Miscellaneous		
Total number of tubes	1948	
Equipment		
Overall HRSG Unit Cost - including:	5.352.000	€
Main Stack	257.450	€
Mechanical		
Mechanical Labor	12.280	hours
Mechanical Labor Cost	453.150	€
Transportation & Rigging		
On-site Transportation & Rigging	239.000	€
Civil		
Foundation Concrete Volume	272	m^3
Civil Labor	5.200	hours

HRSGAssembly[1]		
Overall HRSG Thermodynamic Data		
1. HRSG Summary		
HRSG efficiency	81,58	%
Heat recovered	66040	kW
Heat loss	495,3	kW
Heat available in exhaust gas (cooled to ambient)	80954	kW
HRSG gas inlet temperature	610,9	C
Stack gas exit temperature	120,1	C
HRSG gas inlet mass flow	443	t/h
Stack gas exit mass flow	443	t/h
HRSG gas inlet pressure	1,035	bar
Stack gas exit pressure	1,011	bar
Ambient pressure	1,013	bar
HRSG total gas-side pressure drop to top of stack	24,52	millibar
HRSG total gas-side pressure drop to ambient	21,96	millibar
2. Water/Steam Paths		
Path 1		
Total heat transfer	49162	kW
Steam/water exit		
Pressure	80,72	bar
Temperature	500	C
Mass flow	70,81	t/h
Steam/water inlet		
Pressure	81,97	bar
Temperature	210,8	C
Mass flow	71,52	t/h
Path 2		
Total heat transfer	12879	kW
Steam/water exit		
Pressure	20,57	bar
Temperature	275	C
Mass flow	5,686	t/h
Steam/water inlet		
Pressure	20,86	bar
Temperature	105,7	C

2. HRSG Assembly: Managing



2. HRSG Assembly: Managing

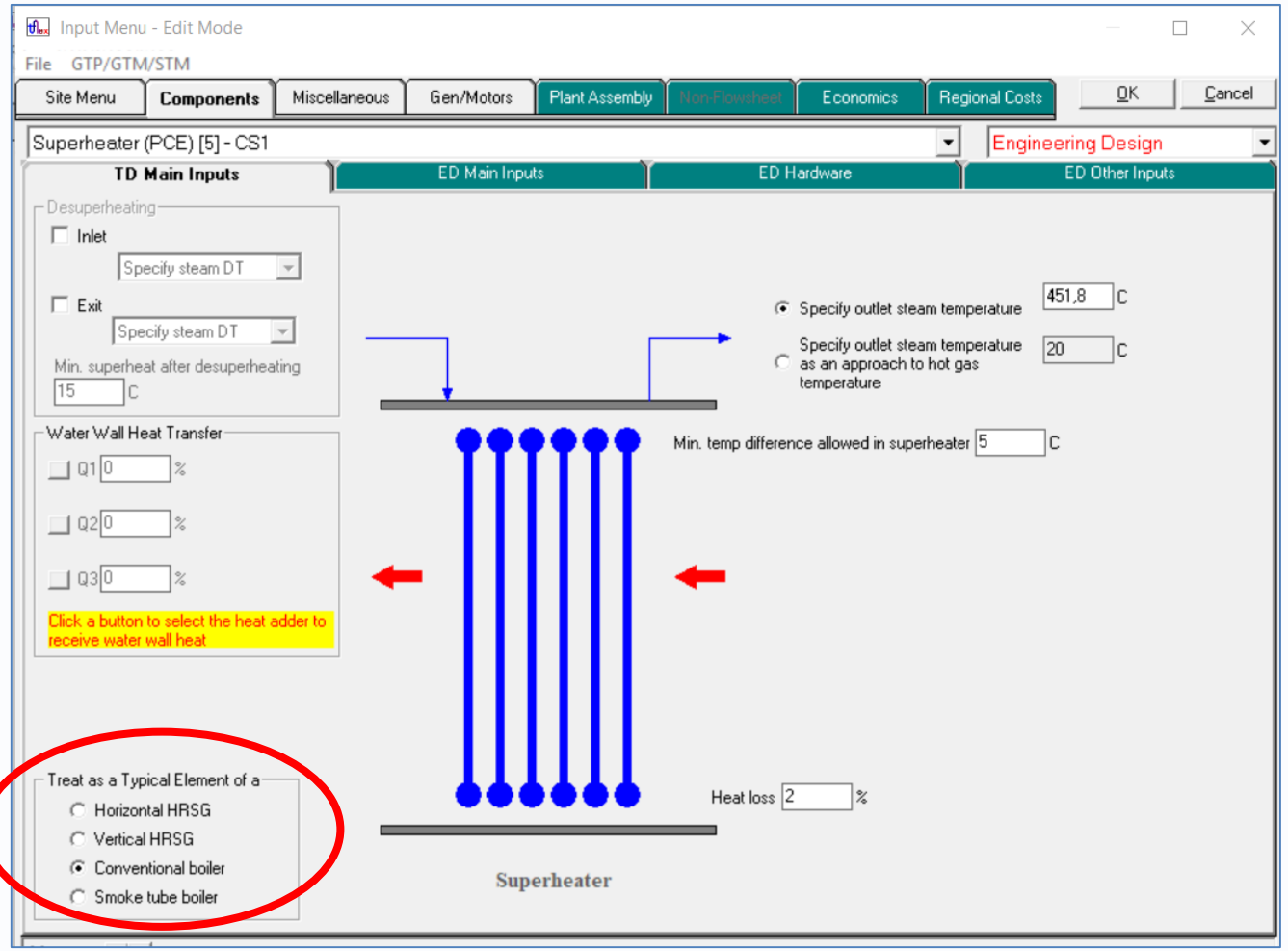


Thermoflow

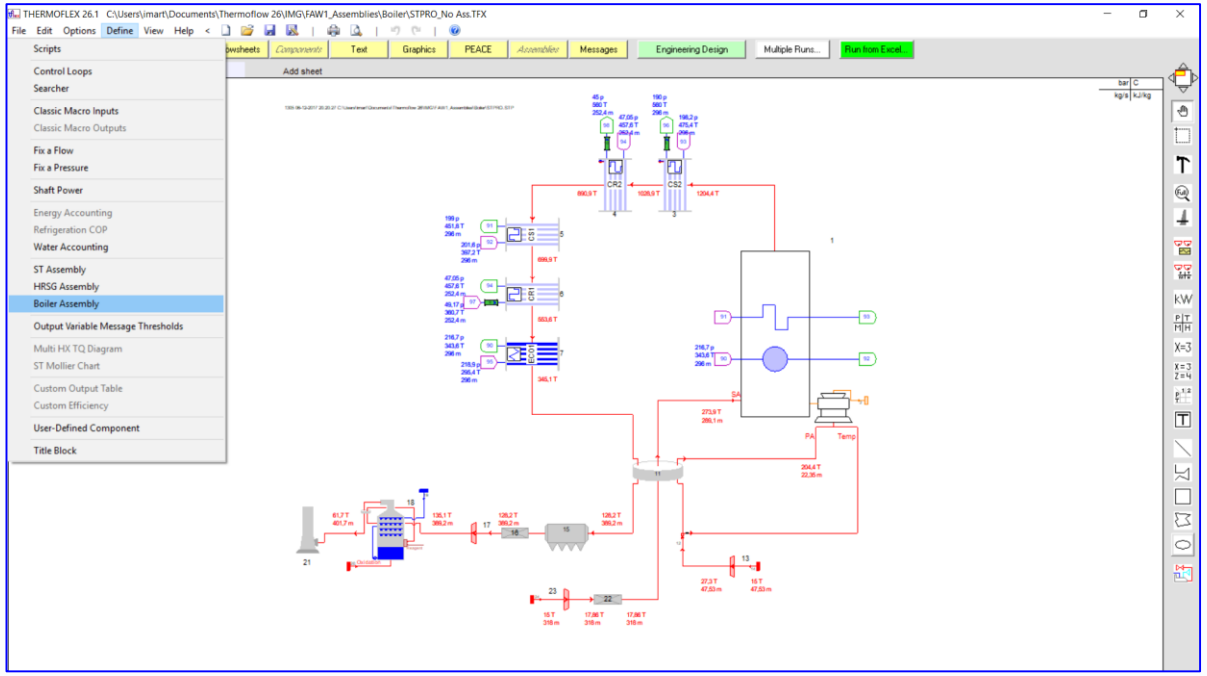
3. Boiler Assembly

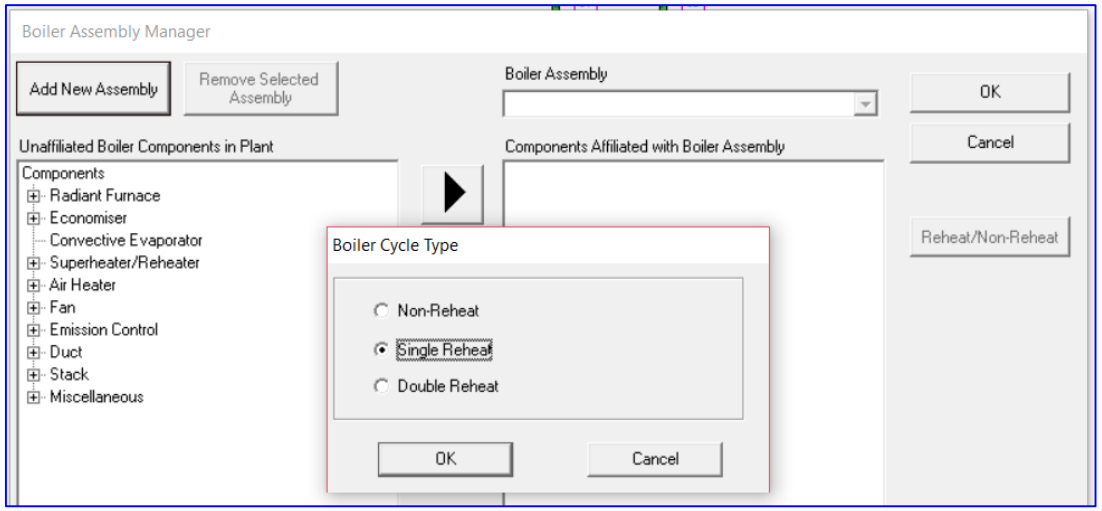
- Boiler Design in TFX. TD and ED
- Boiler Assembly Definition and Requisites
- Boiler Assembly Outputs
- Managing the Boiler Assembly
- Boiler Assembly in OD Mode
- Boiler Assembly in files imported from STP

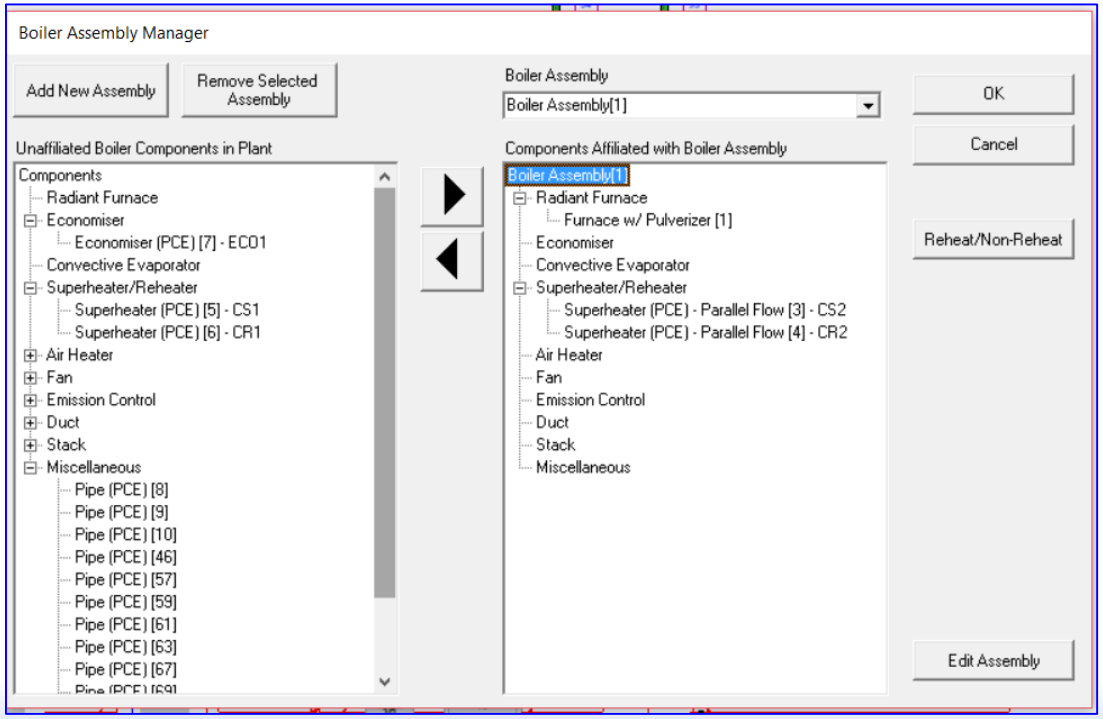
3. Boiler Assembly Definition



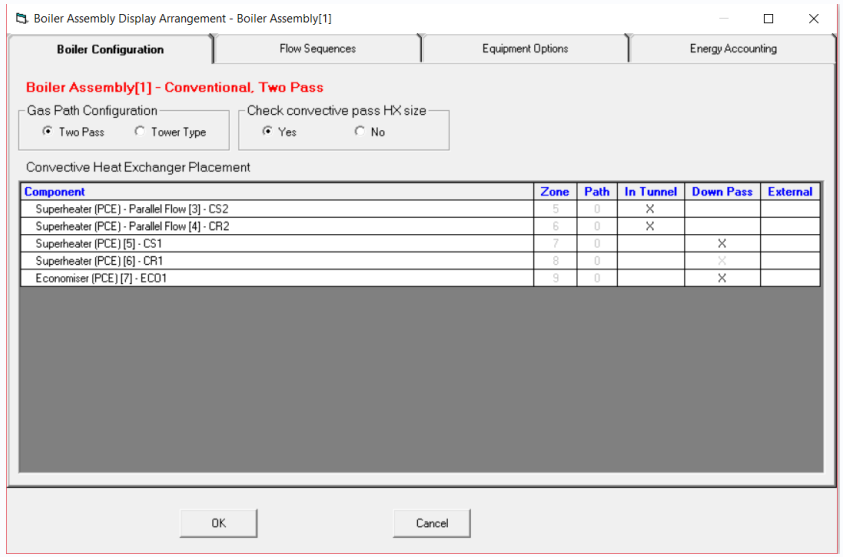
3. Boiler Assembly Definition

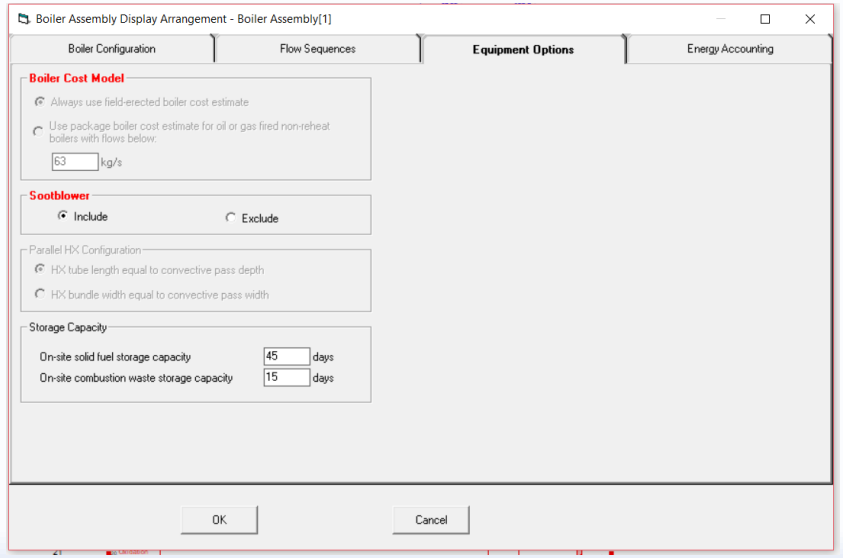


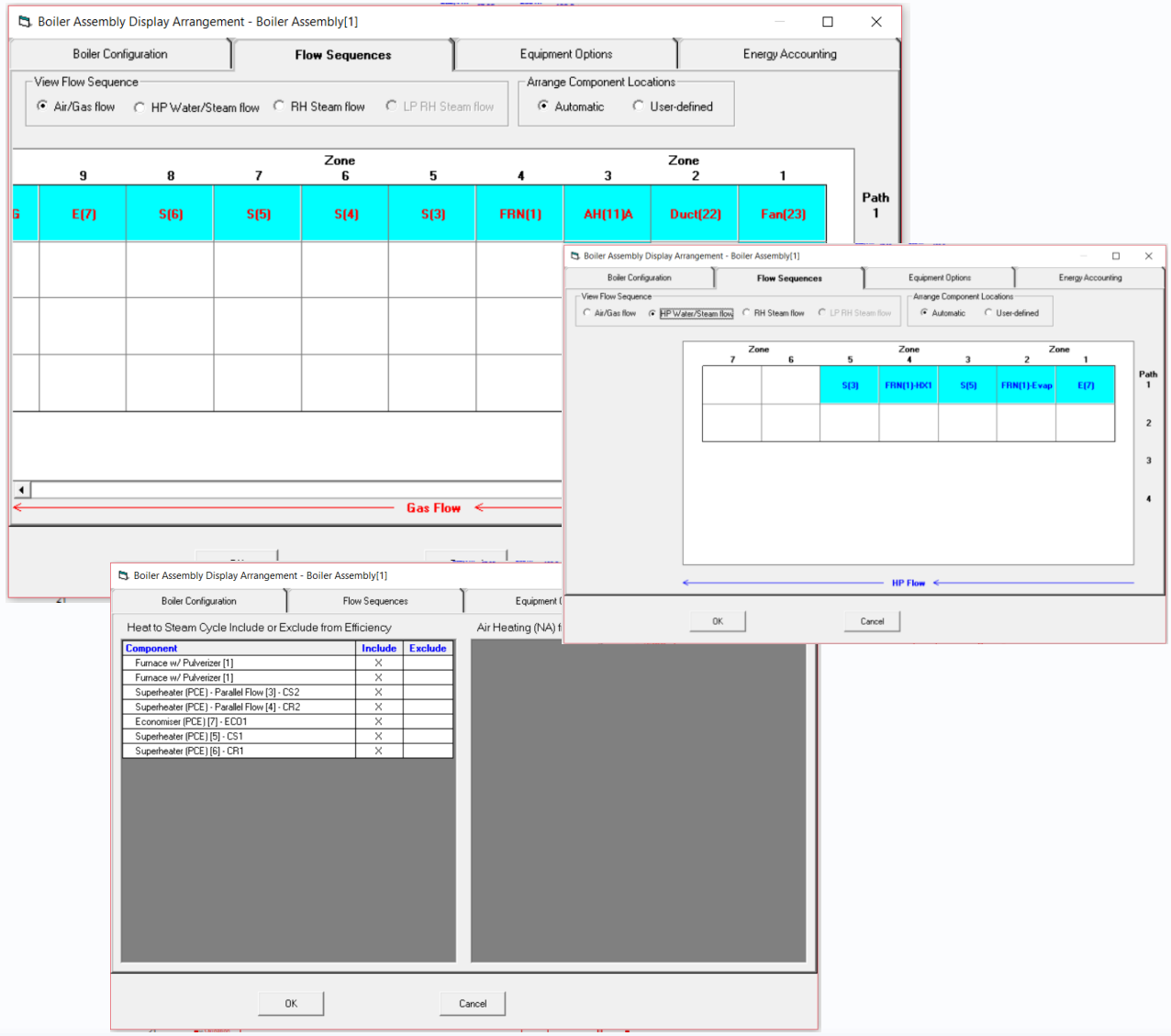




3. Boiler Assembly Arrangement

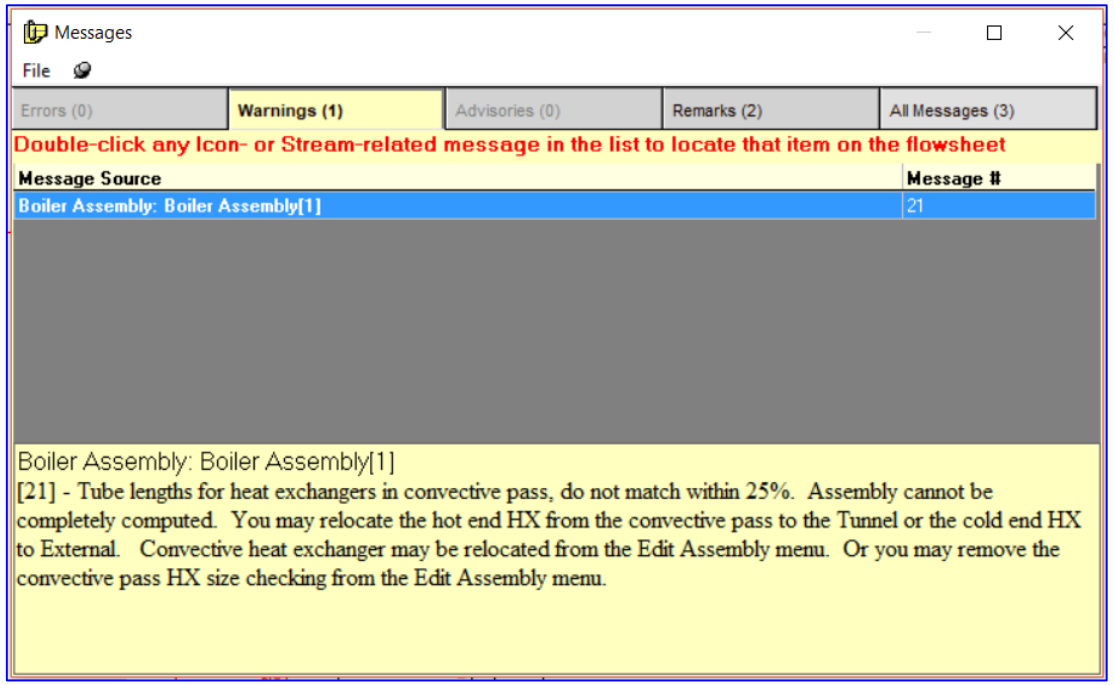


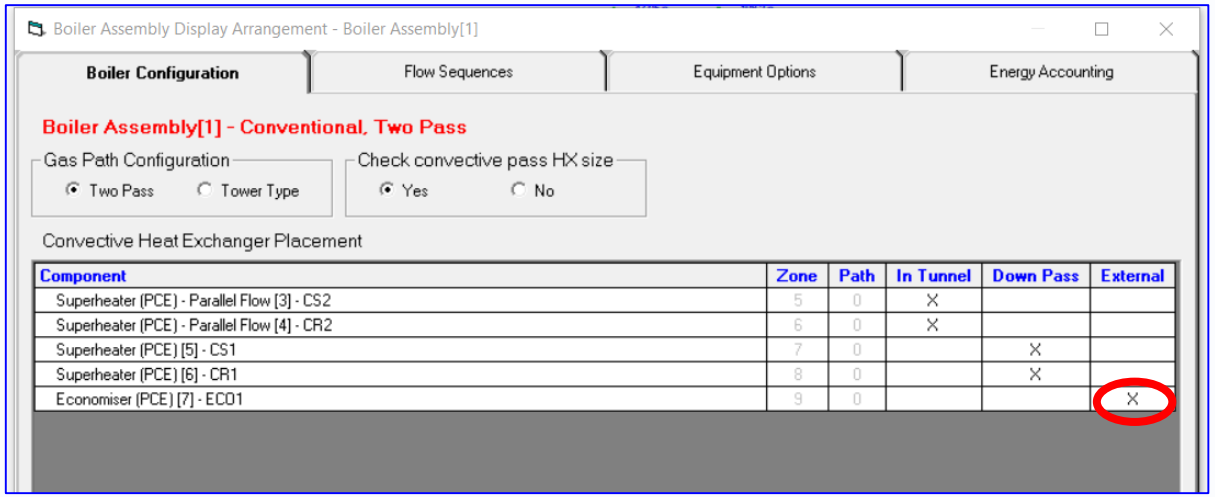


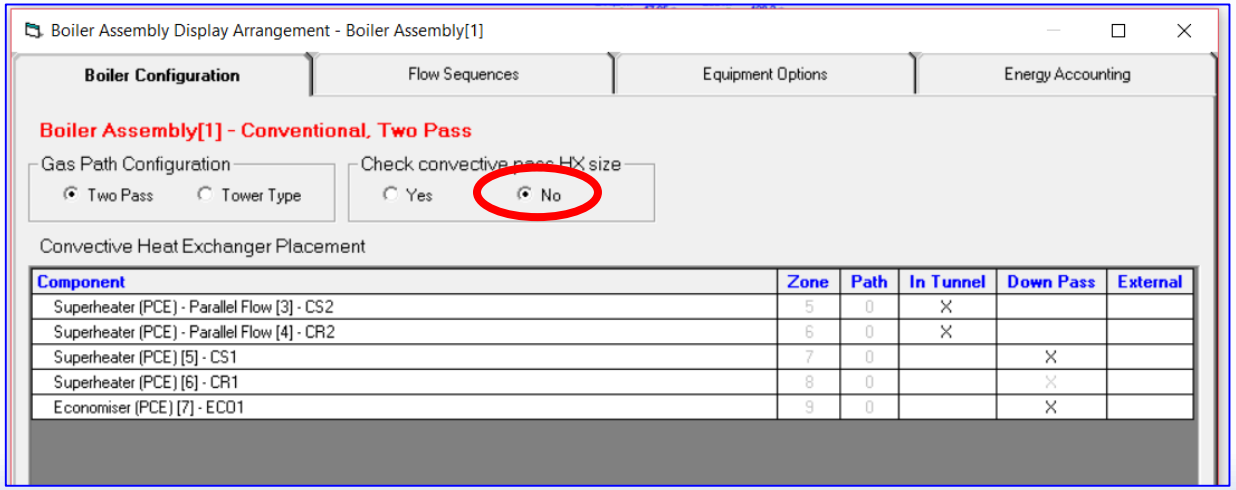


Thermoflow

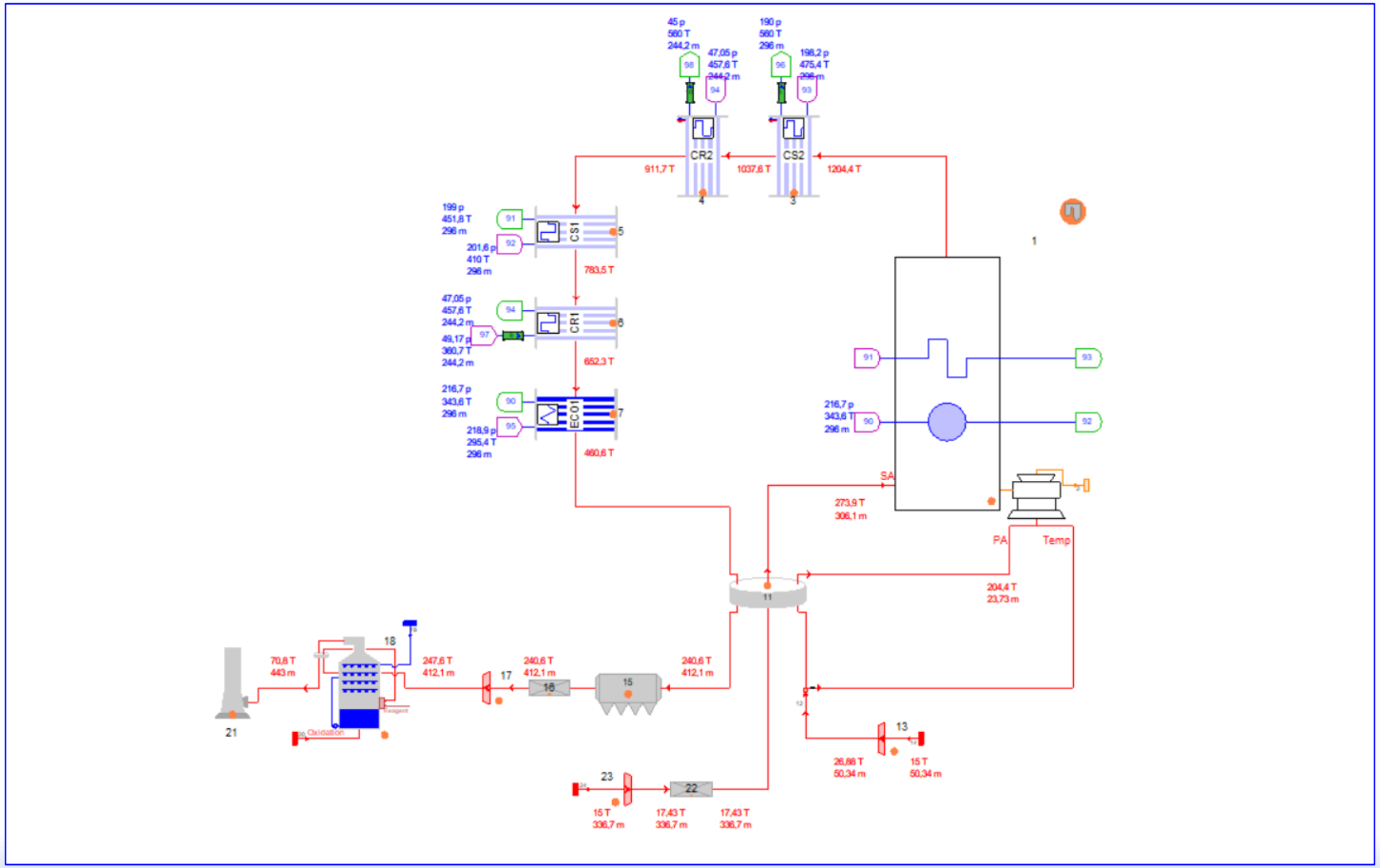
3. Boiler Assembly



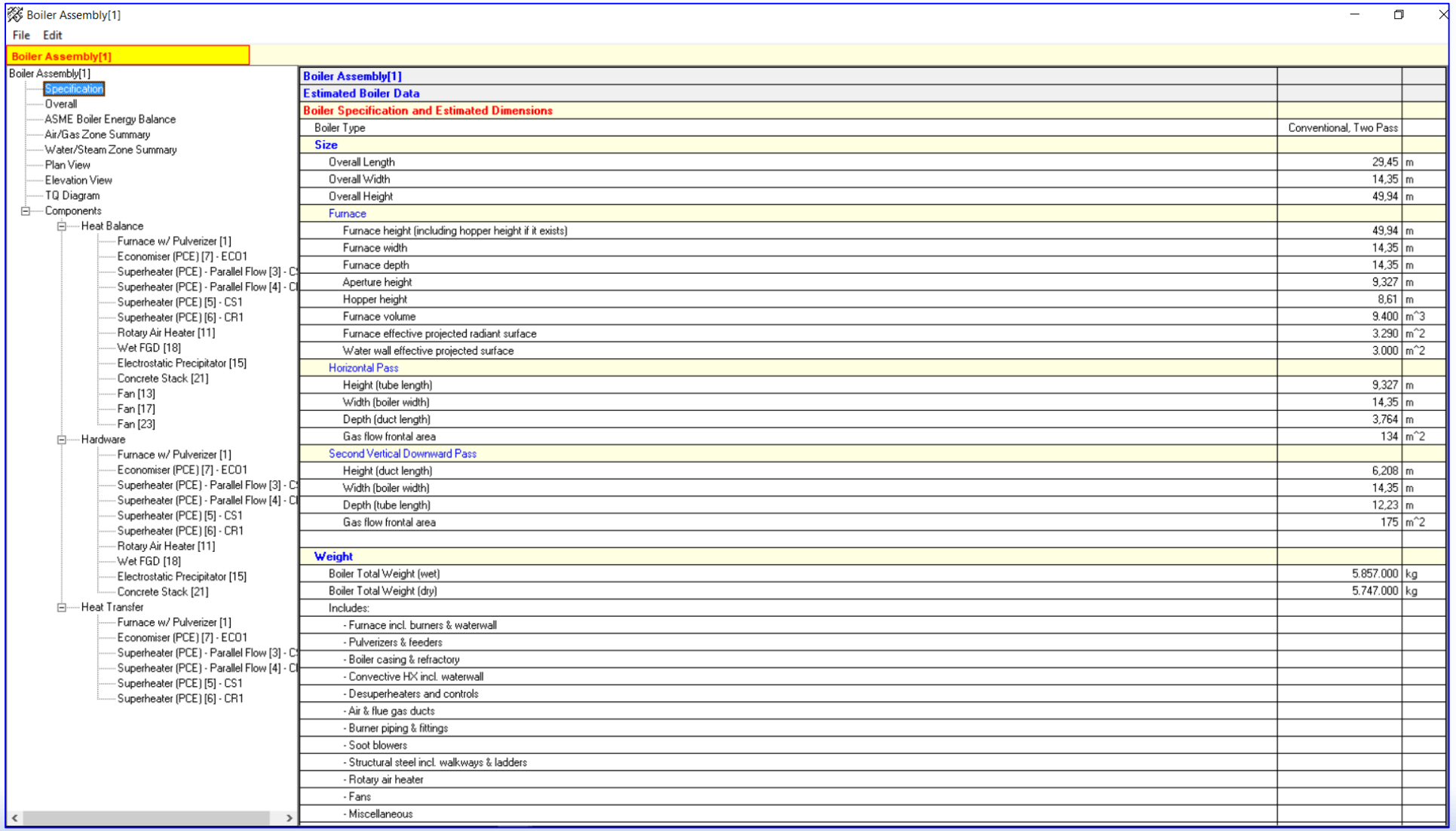




3. Boiler Assembly

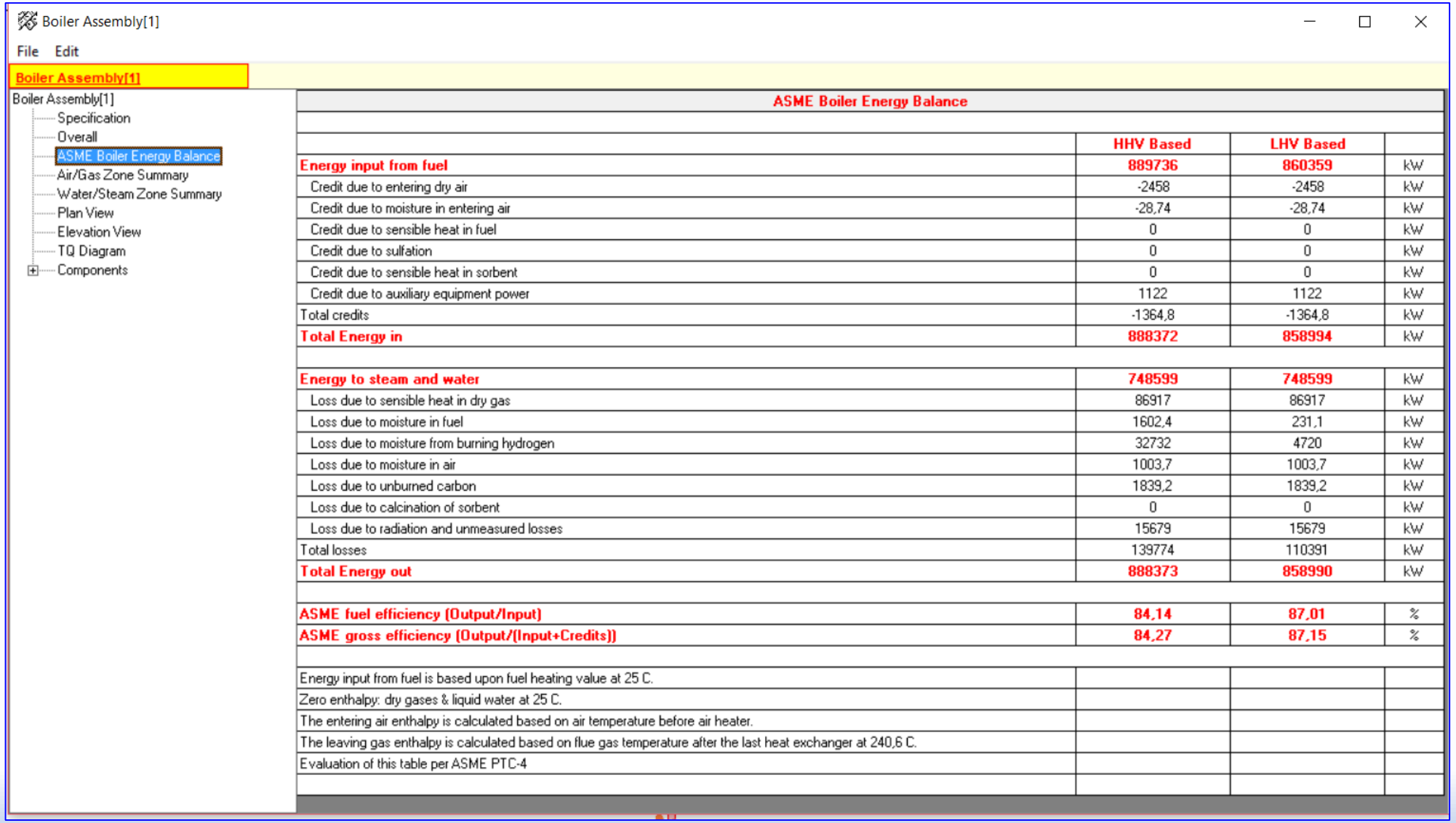


3. Boiler Assembly, Outputs



Boiler Assembly[1]		
Estimated Boiler Data		
Boiler Specification and Estimated Dimensions		
Boiler Type	Conventional, Two Pass	
Size		
Overall Length	29,45	m
Overall Width	14,35	m
Overall Height	49,94	m
Furnace		
Furnace height (including hopper height if it exists)	49,94	m
Furnace width	14,35	m
Furnace depth	14,35	m
Aperture height	9,327	m
Hopper height	8,61	m
Furnace volume	9.400	m^3
Furnace effective projected radiant surface	3.290	m^2
Water wall effective projected surface	3.000	m^2
Horizontal Pass		
Height (tube length)	9,327	m
Width (boiler width)	14,35	m
Depth (duct length)	3,764	m
Gas flow frontal area	134	m^2
Second Vertical Downward Pass		
Height (duct length)	6,208	m
Width (boiler width)	14,35	m
Depth (tube length)	12,23	m
Gas flow frontal area	175	m^2
Weight		
Boiler Total Weight (wet)	5.857.000	kg
Boiler Total Weight (dry)	5.747.000	kg
Includes:		
- Furnace incl. burners & waterwall		
- Pulverizers & feeders		
- Boiler casing & refractory		
- Convective HX incl. waterwall		
- Desuperheaters and controls		
- Air & flue gas ducts		
- Burner piping & fittings		
- Soot blowers		
- Structural steel incl. walkways & ladders		
- Rotary air heater		
- Fans		
- Miscellaneous		

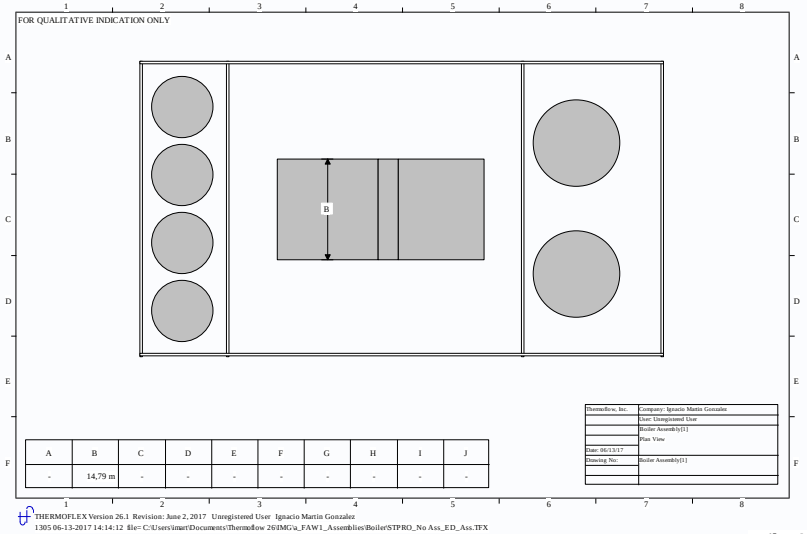
3. Boiler Assembly, Outputs

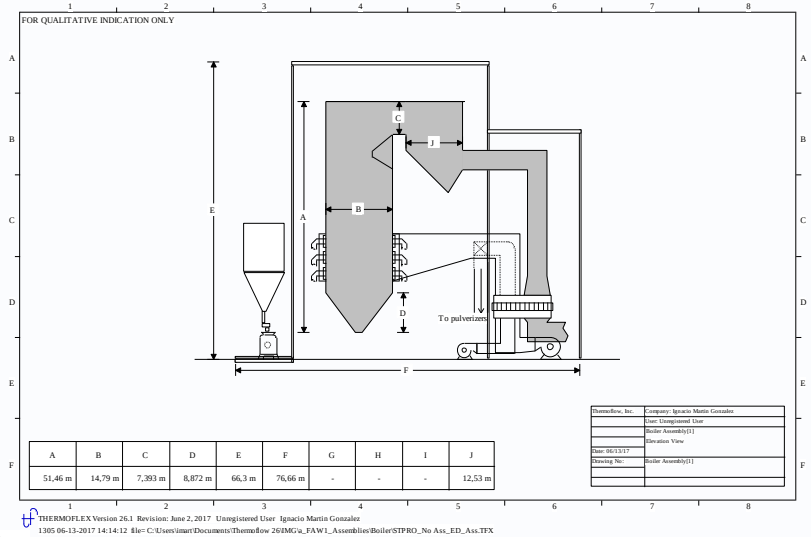


ASME Boiler Energy Balance

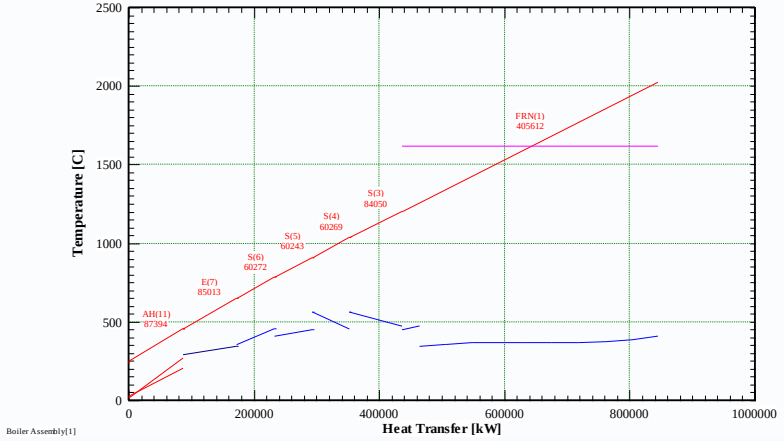
	HHV Based	LHV Based	
Energy input from fuel	**889736**	**860359**	kW
Credit due to entering dry air	-2458	-2458	kW
Credit due to moisture in entering air	-28,74	-28,74	kW
Credit due to sensible heat in fuel	0	0	kW
Credit due to sulfation	0	0	kW
Credit due to sensible heat in sorbent	0	0	kW
Credit due to auxiliary equipment power	1122	1122	kW
Total credits	-1364,8	-1364,8	kW
Total Energy in	**888372**	**858994**	kW
Energy to steam and water	**748599**	**748599**	kW
Loss due to sensible heat in dry gas	86917	86917	kW
Loss due to moisture in fuel	1602,4	231,1	kW
Loss due to moisture from burning hydrogen	32732	4720	kW
Loss due to moisture in air	1003,7	1003,7	kW
Loss due to unburned carbon	1839,2	1839,2	kW
Loss due to calcination of sorbent	0	0	kW
Loss due to radiation and unmeasured losses	15679	15679	kW
Total losses	139774	110391	kW
Total Energy out	**888373**	**858990**	kW
ASME fuel efficiency (Output/Input)	**84,14**	**87,01**	%
ASME gross efficiency (Output/(Input+Credits))	**84,27**	**87,15**	%
Energy input from fuel is based upon fuel heating value at 25 C.			
Zero enthalpy: dry gases & liquid water at 25 C.			
The entering air enthalpy is calculated based on air temperature before air heater.			
The leaving gas enthalpy is calculated based on flue gas temperature after the last heat exchanger at 240,6 C.			
Evaluation of this table per ASME PTC-4			

3. Boiler Assembly, Outputs





Boiler Assembly - Boiler Assembly[1] T-Q Diagram

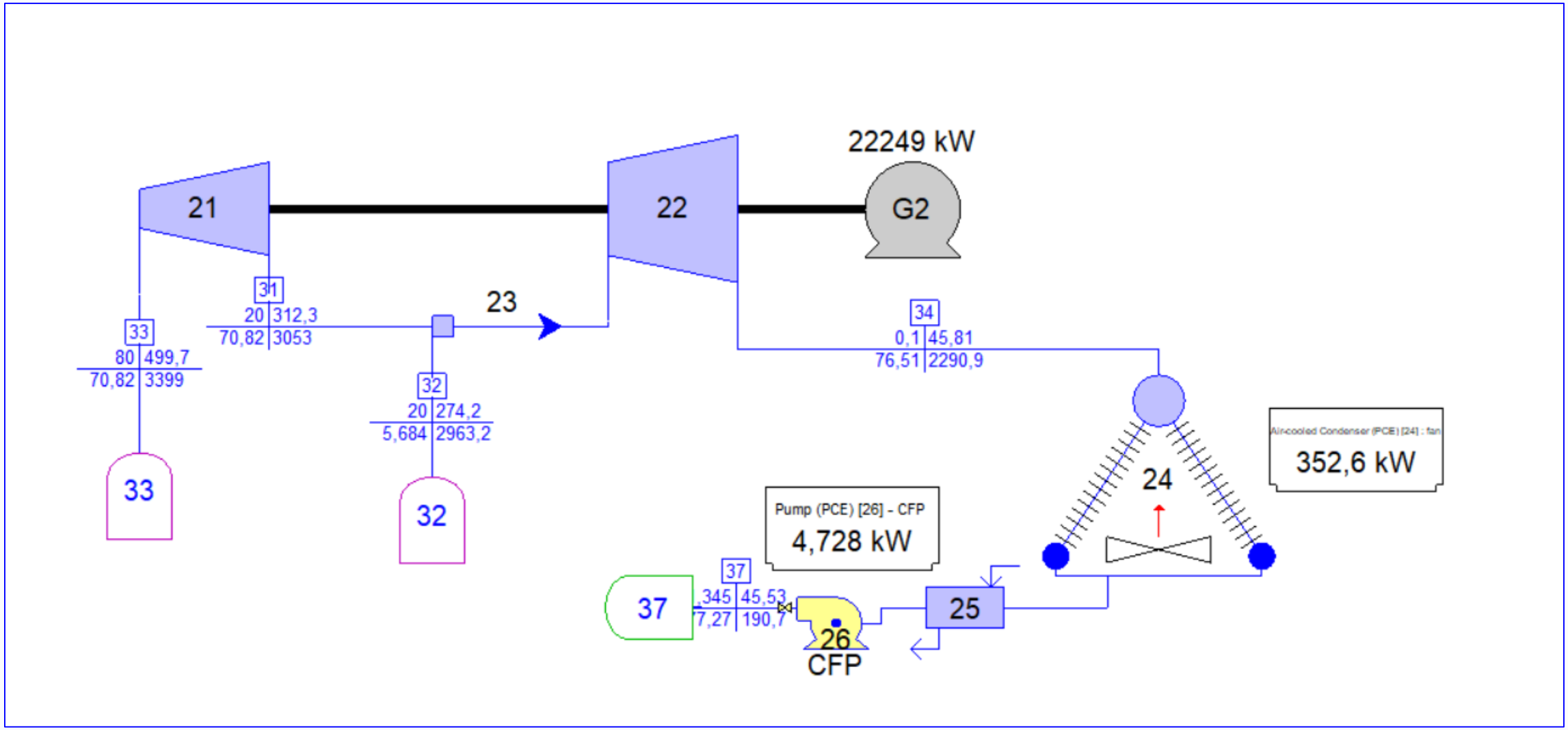


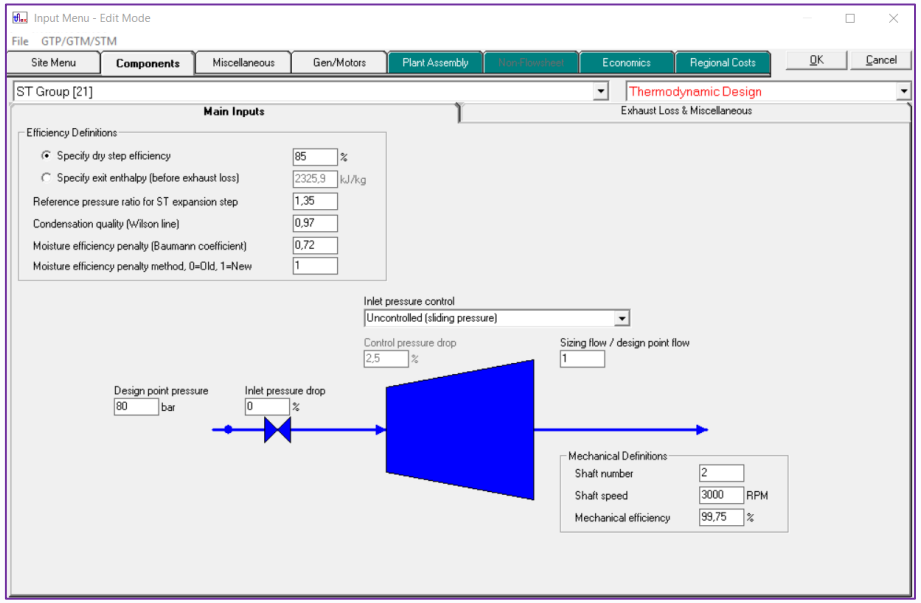
THERMOFLEX Version 26.1 Revision: June 2, 2017 Unregistered User Ignacio Martin Gonzalez
1305 06-13-2017 14:14:12 file= C:\Users\imart\Documents\Thermoflow 26\IMG\u_FAW1_Assemblies\Boiler\STPRO_No Ass_ED_Ass.TFX

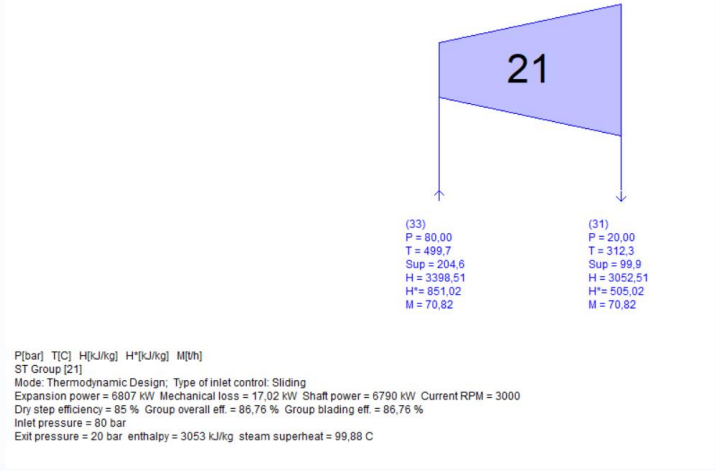
Thermoflow

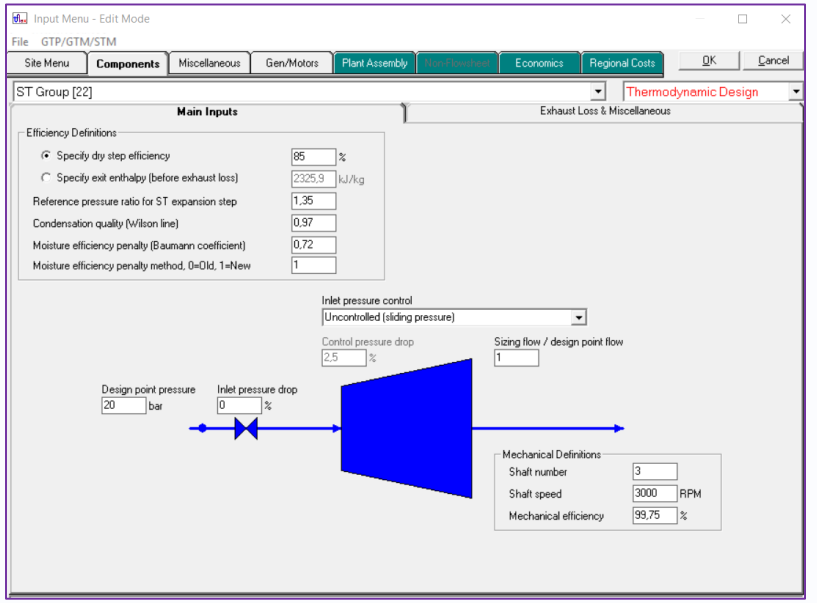
4. Steam Turbine Assembly

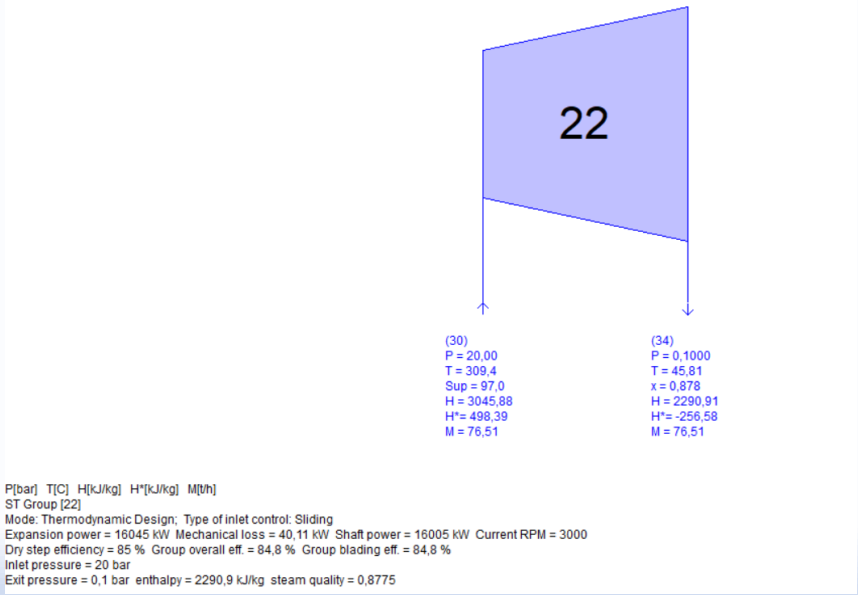
- ST Design in TFX
- ST Assembly Definition and Requisites
- ST Assembly Outputs
- Differences ST Assembly / No Assembly
- Managing the ST Assembly
- Leakage Flows to a TFX Source
- ST Assembly in OD Mode
- ST Assembly in files imported from GTP-GTM-STP


22249 kW
21
22
G2
31
20 312,3
70,82 3053
23
33
80 499,7
70,82 3399
32
20 274,2
5,684 2963,2
34
0,1 45,81
76,51 2290,9
33
32
Air-cooled Condenser (PCE) [24] : fan
352,6 kW
24
Pump (PCE) [26] - CFP
4,728 kW
37
,345 45,53
7,27 190,7
37
25
26
CFP

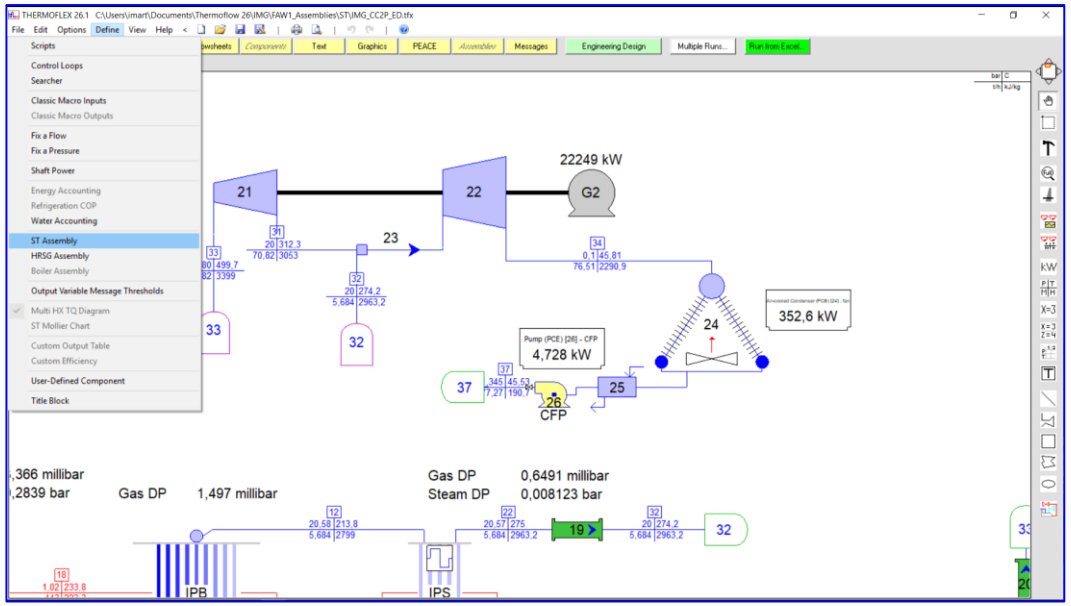

Input Menu - Edit Mode
File GTP/GTM/STM
Site Menu
Components
Miscellaneous
Gen/Motors
Plant Assembly
Non-Flowsheet
Economics
Regional Costs
OK
Cancel
ST Group [21]
Thermodynamic Design
Main Inputs
Exhaust Loss & Miscellaneous
Efficiency Definitions
Specify dry step efficiency 85 %
Specify exit enthalpy (before exhaust loss) 2325,9 kJ/kg
Reference pressure ratio for ST expansion step 1,35
Condensation quality (Wilson line) 0,97
Moisture efficiency penalty (Baumann coefficient) 0,72
Moisture efficiency penalty method, 0=Old, 1=New 1
Inlet pressure control
Uncontrolled (sliding pressure)
Control pressure drop 2,5 %
Sizing flow / design point flow 1
Design point pressure 80 bar
Inlet pressure drop 0 %
Mechanical Definitions
Shaft number 2
Shaft speed 3000 RPM
Mechanical efficiency 99,75 %

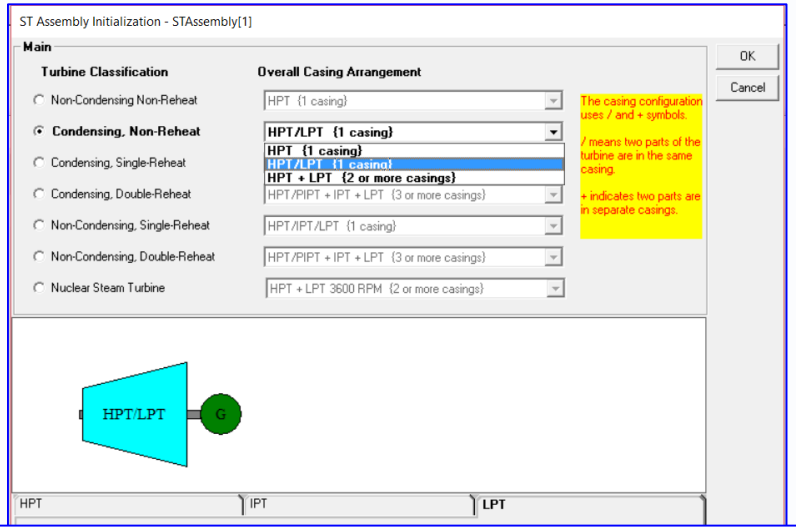

21
(33)
P = 80,00
T = 499,7
Sup = 204,6
H = 3398,51
H*= 851,02
M = 70,82
(31)
P = 20,00
T = 312,3
Sup = 99,9
H = 3052,51
H*= 505,02
M = 70,82
P[bar] T[C] H[kJ/kg] H*[kJ/kg] M[t/h]
ST Group [21]
Mode: Thermodynamic Design; Type of inlet control: Sliding
Expansion power = 6807 kW Mechanical loss = 17,02 kW Shaft power = 6790 kW Current RPM = 3000
Dry step efficiency = 85 % Group overall eff. = 86,76 % Group blading eff. = 86,76 %
Inlet pressure = 80 bar
Exit pressure = 20 bar enthalpy = 3053 kJ/kg steam superheat = 99,88 C

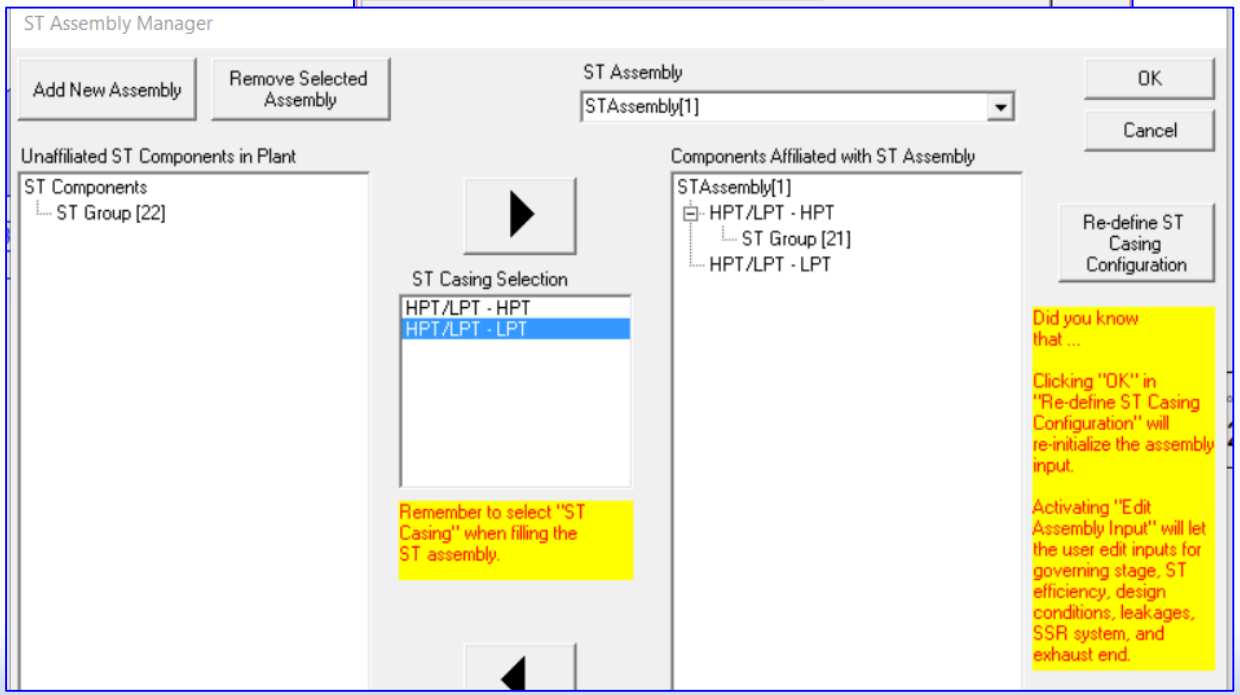

Input Menu - Edit Mode
File GTP/GTM/STM
Site Menu
Components
Miscellaneous
Gen/Motors
Plant Assembly
Non-Flowsheet
Economics
Regional Costs
OK
Cancel
ST Group [22]
Thermodynamic Design
Main Inputs
Exhaust Loss & Miscellaneous
Efficiency Definitions
Specify dry step efficiency 85 %
Specify exit enthalpy (before exhaust loss) 2325,9 kJ/kg
Reference pressure ratio for ST expansion step 1,35
Condensation quality (Wilson line) 0,97
Moisture efficiency penalty (Baumann coefficient) 0,72
Moisture efficiency penalty method, 0=Old, 1=New 1
Inlet pressure control
Uncontrolled (sliding pressure)
Control pressure drop 2,5 %
Sizing flow / design point flow 1
Design point pressure 20 bar
Inlet pressure drop 0 %
Mechanical Definitions
Shaft number 3
Shaft speed 3000 RPM
Mechanical efficiency 99,75 %

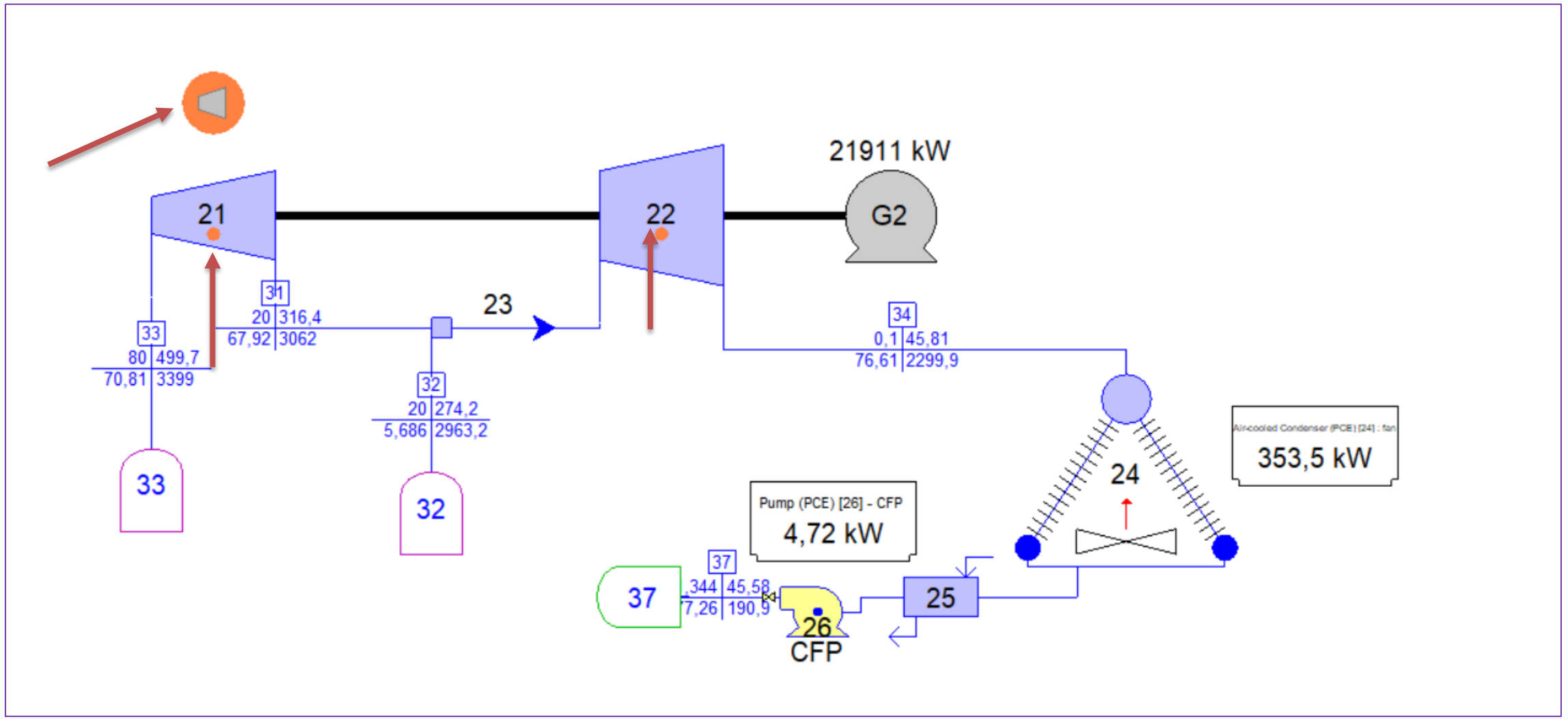

22
(30)
P = 20,00
T = 309,4
Sup = 97,0
H = 3045,88
H*= 498,39
M = 76,51
(34)
P = 0,1000
T = 45,81
x = 0,878
H = 2290,91
H*= -256,58
M = 76,51
P[bar] T[C] H[kJ/kg] H*[kJ/kg] M[t/h]
ST Group [22]
Mode: Thermodynamic Design; Type of inlet control: Sliding
Expansion power = 16045 kW Mechanical loss = 40,11 kW Shaft power = 16005 kW Current RPM = 3000
Dry step efficiency = 85 % Group overall eff. = 84,8 % Group blading eff. = 84,8 %
Inlet pressure = 20 bar
Exit pressure = 0,1 bar enthalpy = 2290,9 kJ/kg steam quality = 0,8775

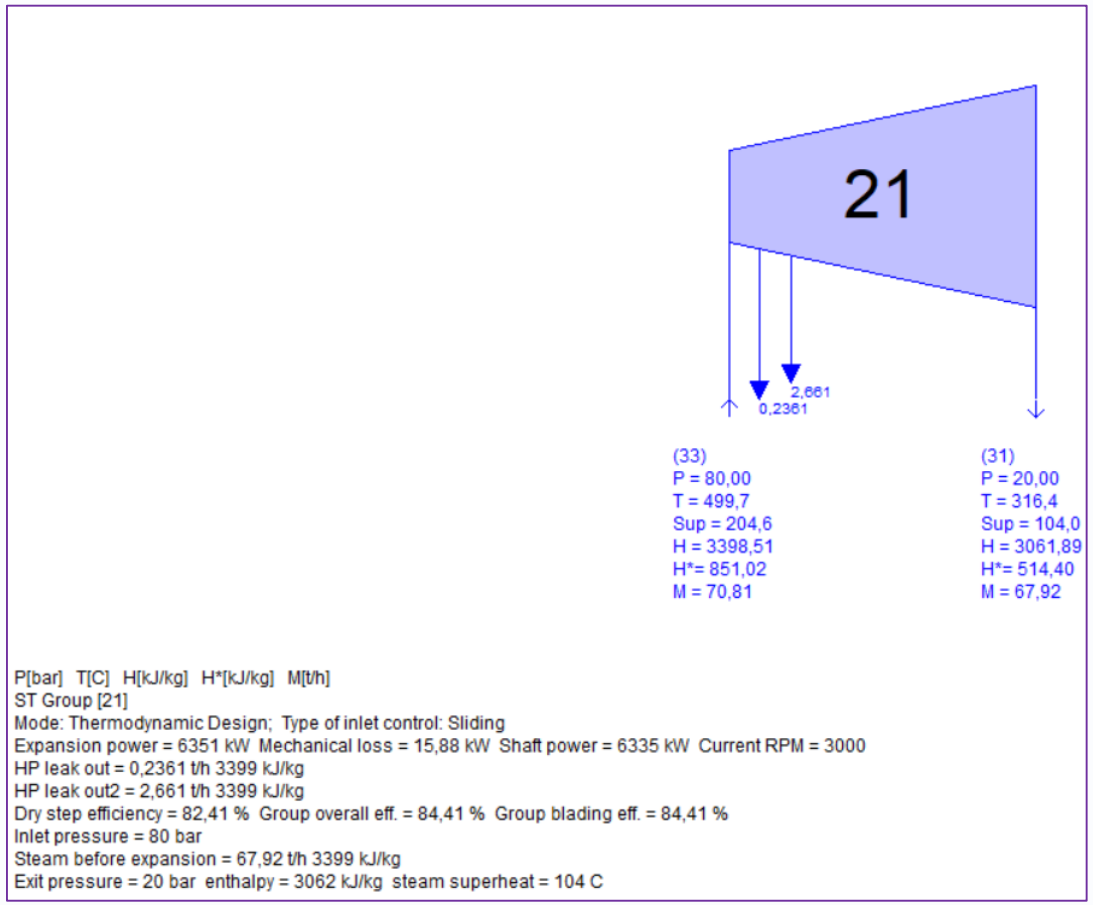
4. Steam Turbine Assembly Definition



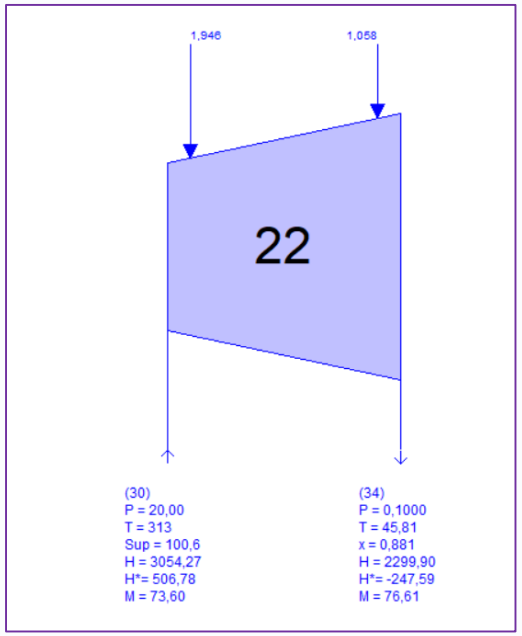




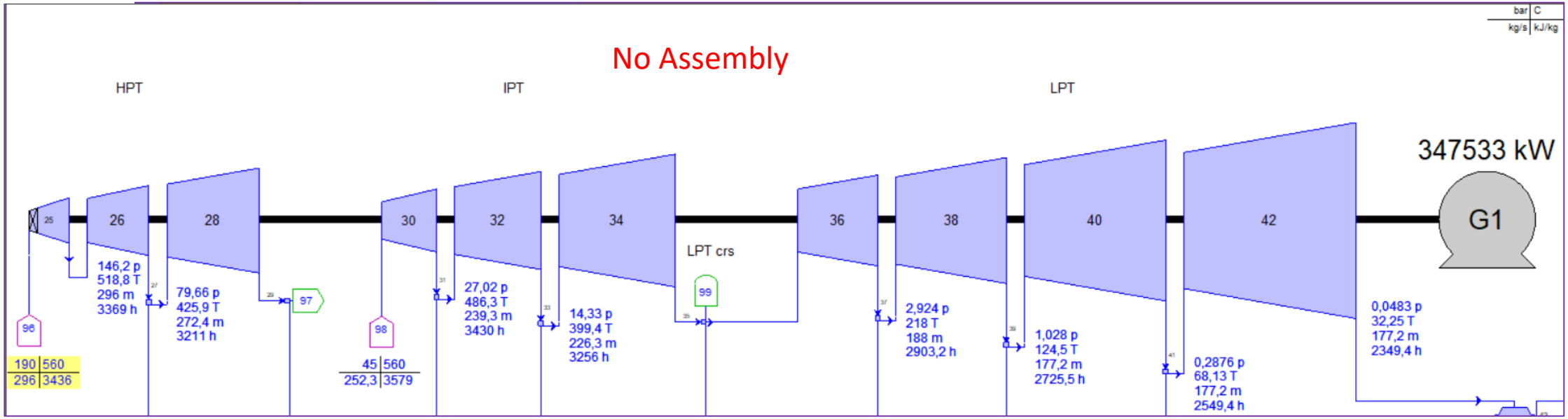

21911 kW
21
22
G2
23
31
20 316,4
67,92 3062
33
80 499,7
70,81 3399
32
20 274,2
5,686 2963,2
34
0,1 45,81
76,61 2299,9
33
32
24
Air-cooled Condenser (PCE) [24] : fan
353,5 kW
Pump (PCE) [26] - CFP
4,72 kW
37
,344 45,58
7,26 190,9
37
26
CFP
25

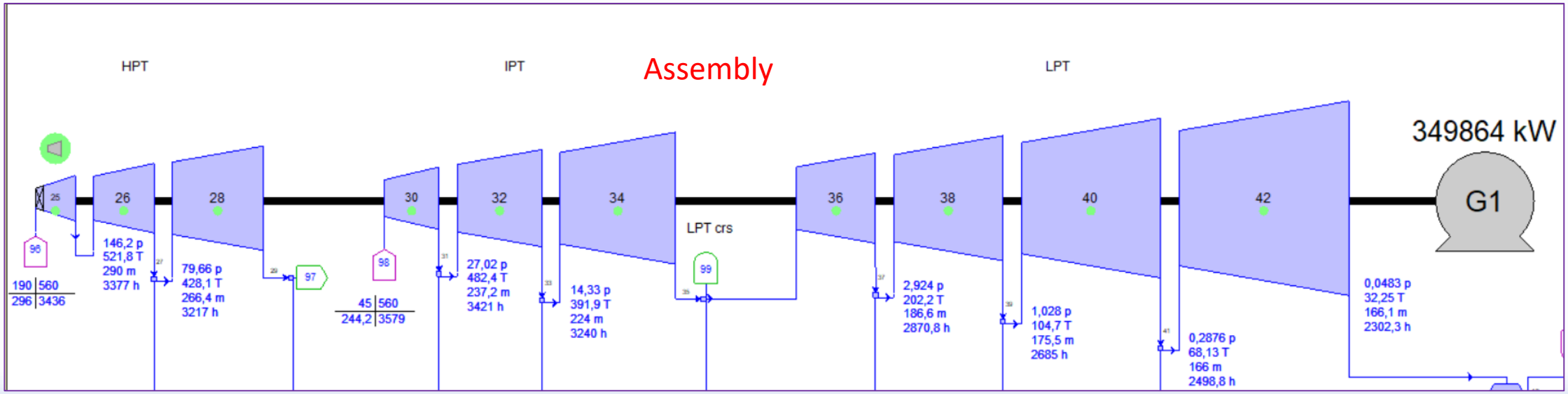


P[bar] T[C] H[kJ/kg] H*[kJ/kg] M[t/h]
ST Group [21]
Mode: Thermodynamic Design; Type of inlet control: Sliding
Expansion power = 6351 kW Mechanical loss = 15,88 kW Shaft power = 6335 kW Current RPM = 3000
HP leak out = 0,2361 t/h 3399 kJ/kg
HP leak out2 = 2,661 t/h 3399 kJ/kg
Dry step efficiency = 82,41 % Group overall eff. = 84,41 % Group blading eff. = 84,41 %
Inlet pressure = 80 bar
Steam before expansion = 67,92 t/h 3399 kJ/kg
Exit pressure = 20 bar enthalpy = 3062 kJ/kg steam superheat = 104 C

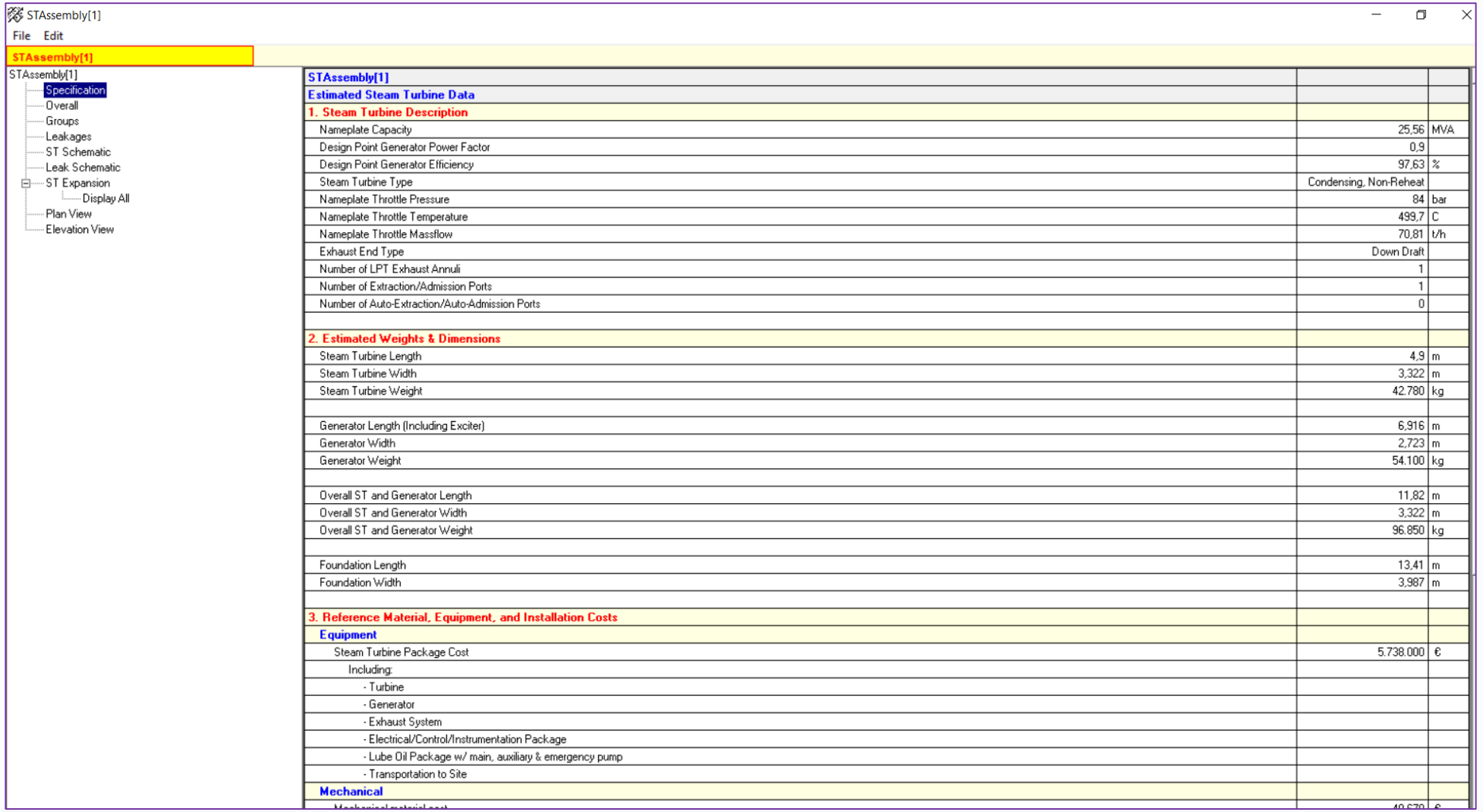


P[bar] T[C] H[kJ/kg] H*[kJ/kg] M[t/h]
ST Group [22]
Mode: Thermodynamic Design; Type of inlet control: Sliding
Expansion power = 16156 kW Mechanical loss = 40,39 kW Shaft power = 16116 kW Current RPM = 3000
HP leak in = 1,946 t/h 3399 kJ/kg
LP leak in = 1,058 t/h 2772,6 kJ/kg
Dry step efficiency = 86,53 % Group overall eff. = 85,71 % Group blading eff. = 86,21 %
Inlet pressure = 20 bar
Steam before expansion = 75,55 t/h 3063 kJ/kg
Expansion line end point = 2288,8 kJ/kg
Exit pressure = 0,1 bar enthalpy = 2299,9 kJ/kg steam quality = 0,8813
Exhaust loss = 4,502 kJ/kg Dry exhaust loss = 6,418 kJ/kg
Annulus velocity (before Exhaust Loss) = 115,2 m/s Volumetric flow per end (before Exhaust Loss) = 269,9 m^3/s
Exhaust end dimensions:
Number of ends: 1
Last stage rotor exit angle: 65,56 degrees
Blade length: 461,7 mm
Pitch diameter: 1614,6 mm
Annulus area/end: 2,342 m^2


No Assembly
bar | C
kg/s | kJ/kg
HPT
IPT
LPT
347533 kW
G1
LPT crs
25
26
28
30
32
34
36
38
40
42
96
97
98
99
146,2 p
518,8 T
296 m
3369 h
79,66 p
425,9 T
272,4 m
3211 h
27,02 p
486,3 T
239,3 m
3430 h
14,33 p
399,4 T
226,3 m
3256 h
2,924 p
218 T
188 m
2903,2 h
1,028 p
124,5 T
177,2 m
2725,5 h
0,2876 p
68,13 T
177,2 m
2549,4 h
0,0483 p
32,25 T
177,2 m
2349,4 h
190 | 560
296 | 3436
45 | 560
252,3 | 3579


Assembly
HPT
IPT
LPT
349864 kW
G1
LPT crs
25
26
28
30
32
34
36
38
40
42
96
97
98
99
146,2 p
521,8 T
290 m
3377 h
79,66 p
428,1 T
266,4 m
3217 h
27,02 p
482,4 T
237,2 m
3421 h
14,33 p
391,9 T
224 m
3240 h
2,924 p
202,2 T
186,6 m
2870,8 h
1,028 p
104,7 T
175,5 m
2685 h
0,2876 p
68,13 T
166 m
2498,8 h
0,0483 p
32,25 T
166,1 m
2302,3 h
190 | 560
296 | 3436
45 | 560
244,2 | 3579

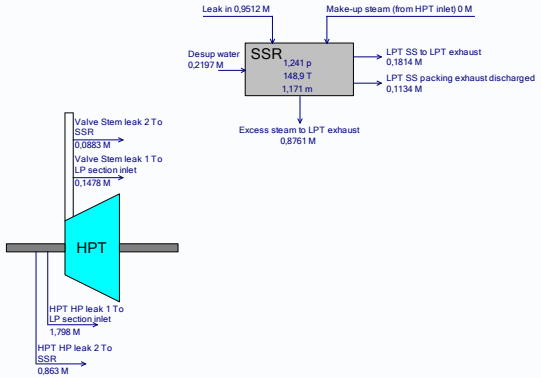
4. Steam Turbine Assembly Outputs



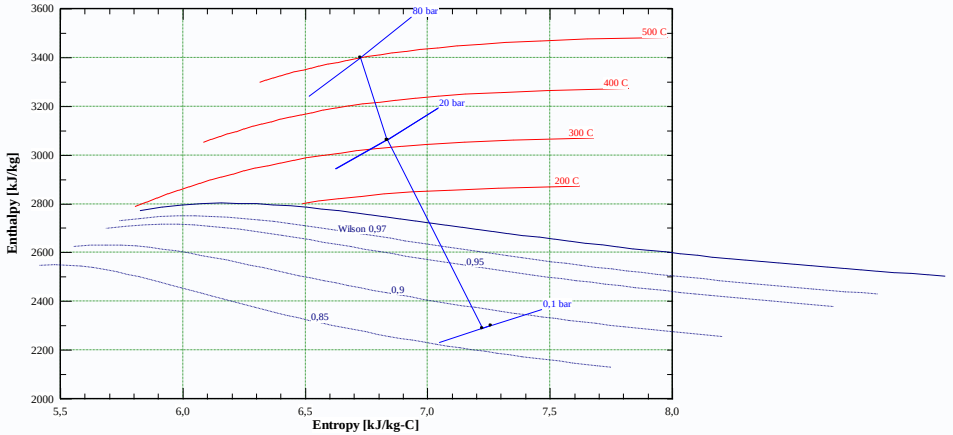
STAssembly[1]		
Estimated Steam Turbine Data		
1. Steam Turbine Description		
Nameplate Capacity	25,56	MVA
Design Point Generator Power Factor	0,9	
Design Point Generator Efficiency	97,63	%
Steam Turbine Type	Condensing, Non-Reheat	
Nameplate Throttle Pressure	84	bar
Nameplate Throttle Temperature	499,7	C
Nameplate Throttle Massflow	70,81	t/h
Exhaust End Type	Down Draft	
Number of LPT Exhaust Annuli	1	
Number of Extraction/Admission Ports	1	
Number of Auto-Extraction/Auto-Admission Ports	0	
2. Estimated Weights & Dimensions		
Steam Turbine Length	4,9	m
Steam Turbine Width	3,322	m
Steam Turbine Weight	42.780	kg
Generator Length (Including Exciter)	6,916	m
Generator Width	2,723	m
Generator Weight	54.100	kg
Overall ST and Generator Length	11,82	m
Overall ST and Generator Width	3,322	m
Overall ST and Generator Weight	96.850	kg
Foundation Length	13,41	m
Foundation Width	3,987	m
3. Reference Material, Equipment, and Installation Costs		
Equipment		
Steam Turbine Package Cost	5.738.000	€
Including:		
- Turbine		
- Generator		
- Exhaust System		
- Electrical/Control/Instrumentation Package		
- Lube Oil Package w/ main, auxiliary & emergency pump		
- Transportation to Site		
Mechanical		

4. Steam Turbine Assembly Outputs

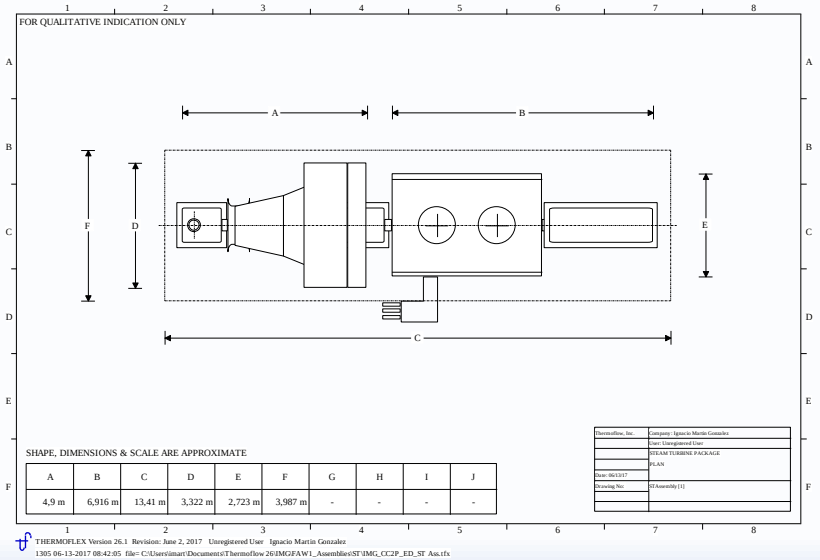
STAssembly[1]

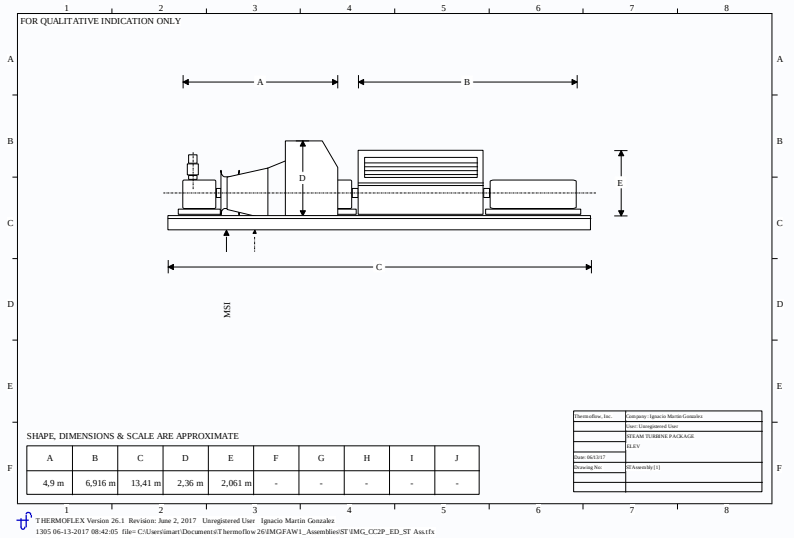


STAssembly[1]: Steam Turbine Expansion Path

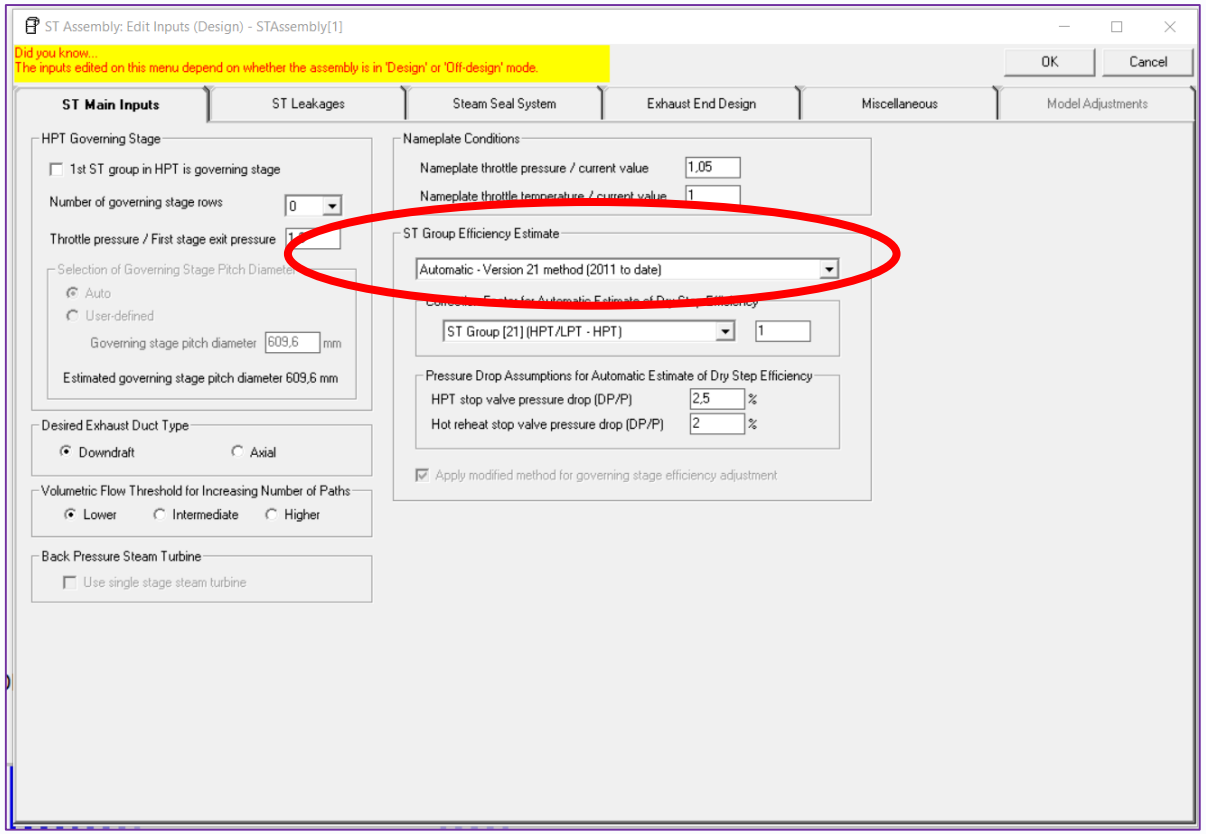


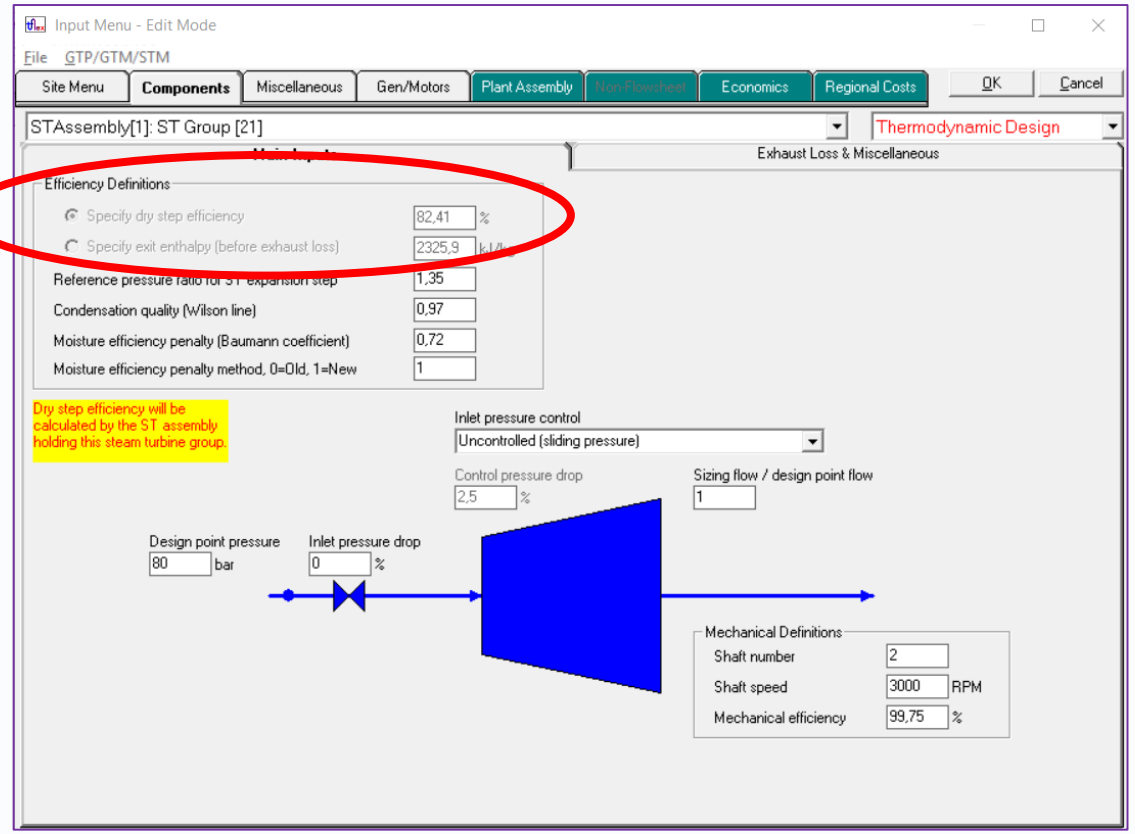
p[bar], T[C], h[kJ/kg], M[t/h]



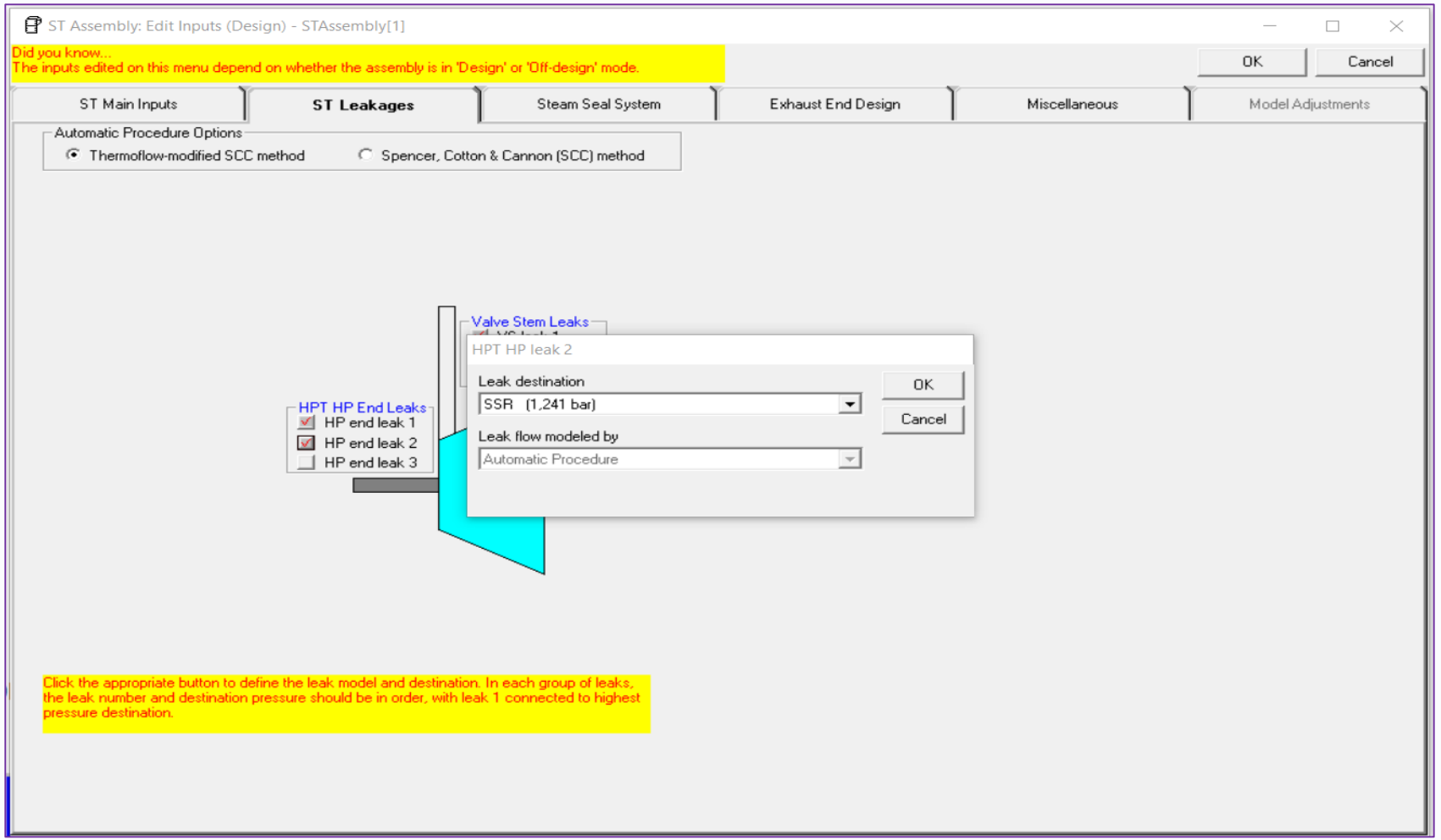


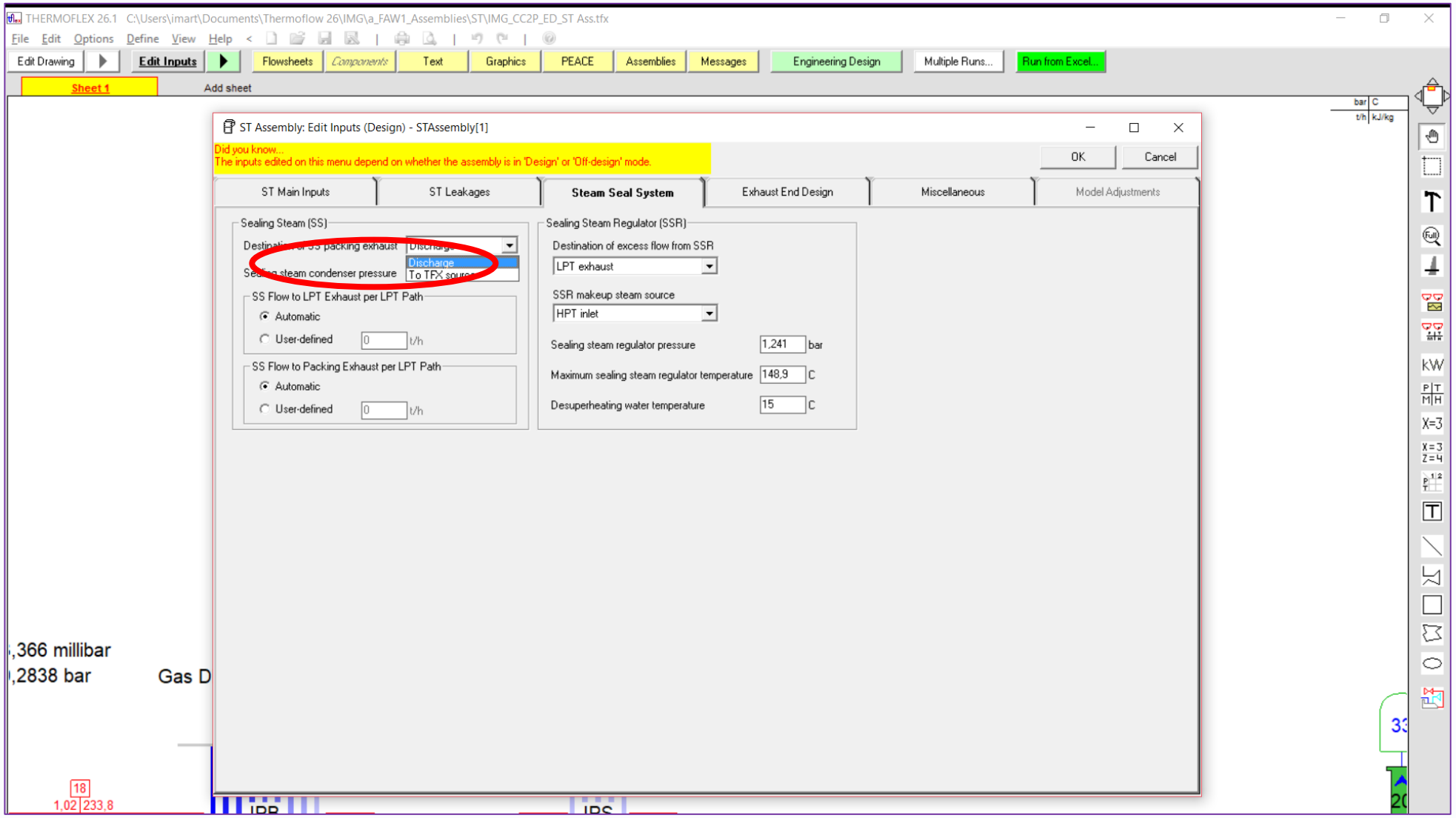
4. ST Assembly, Efficiency Definition



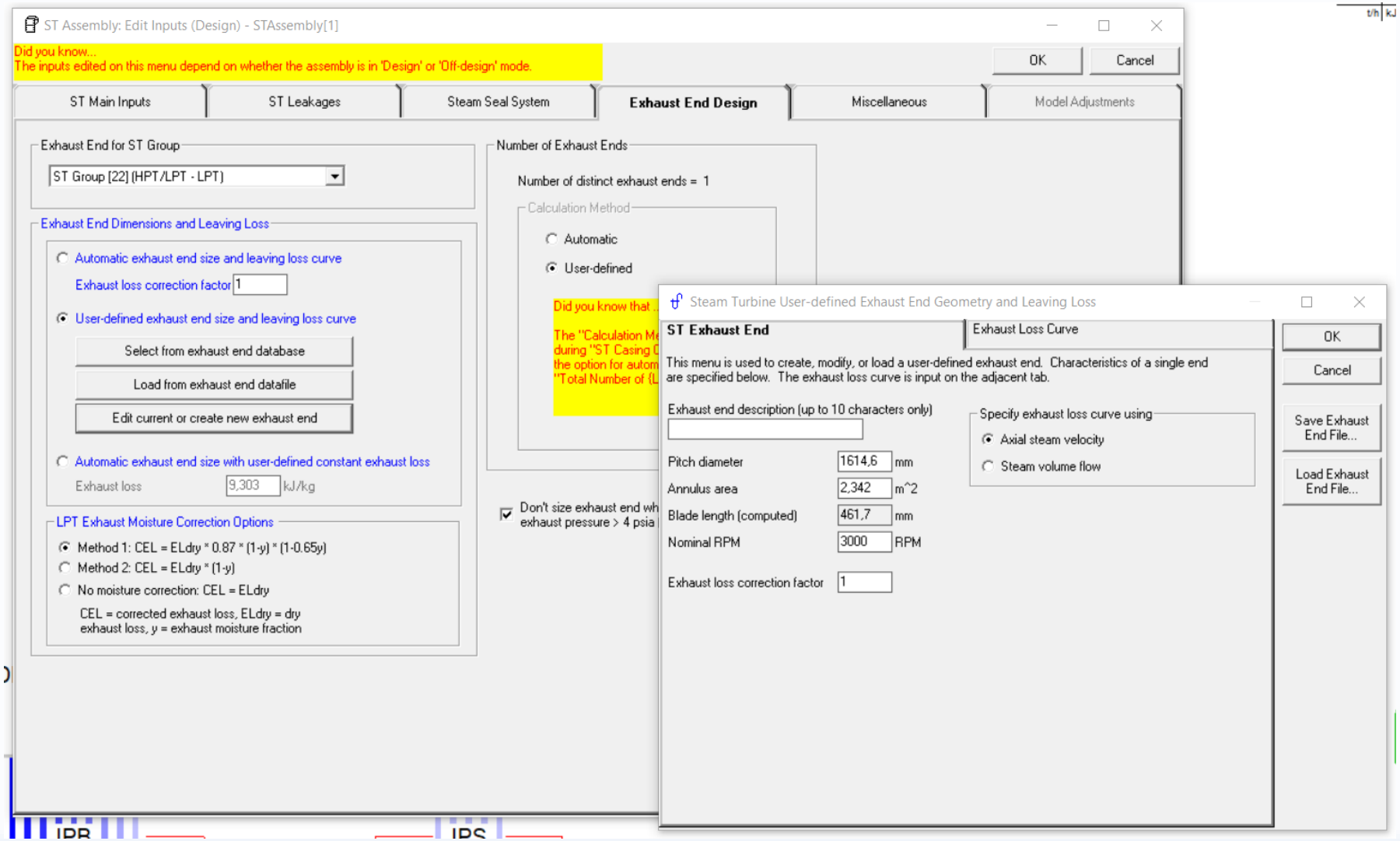


4. ST Assembly: Leakage to TFX Source

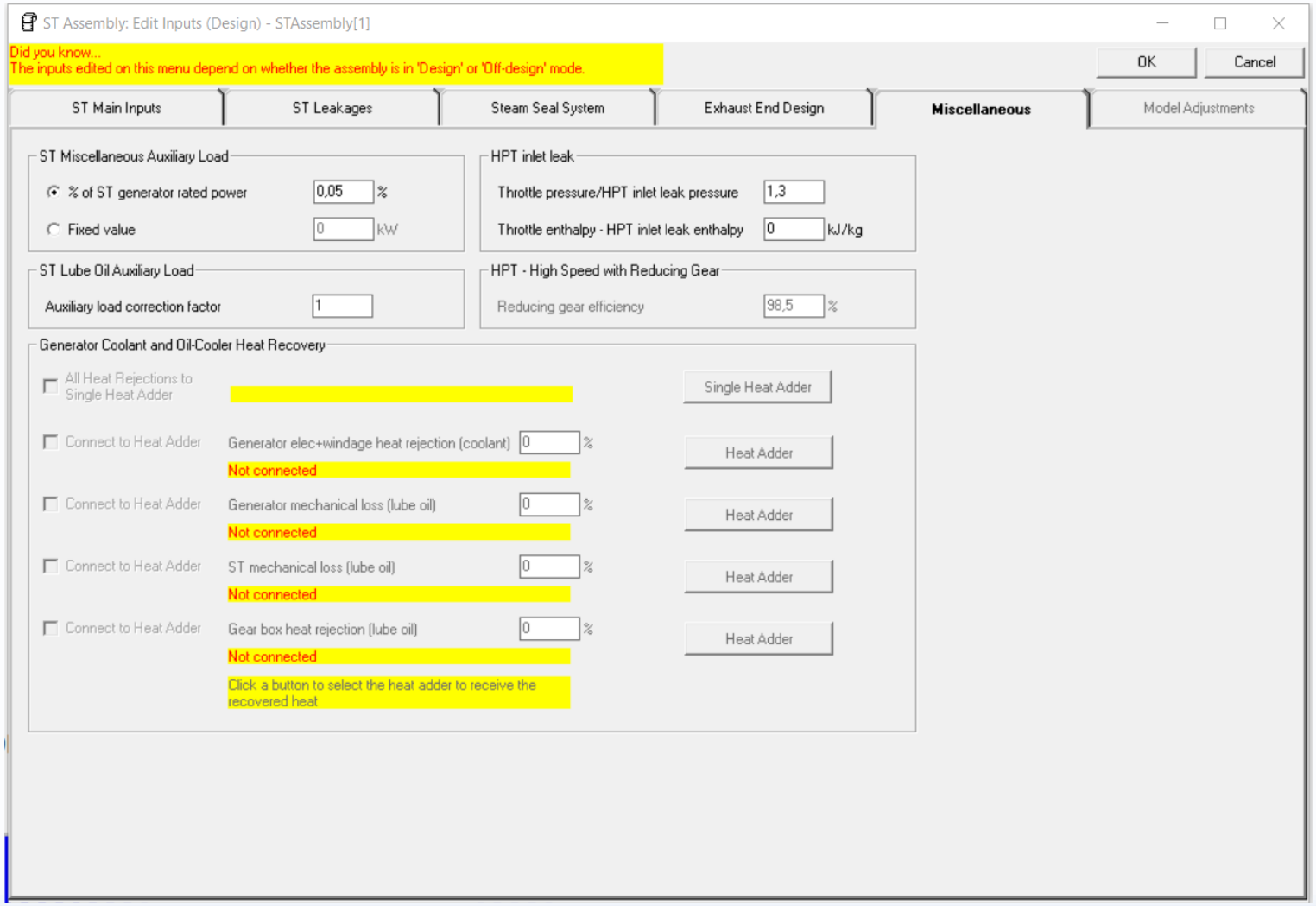



THERMOFLEX 26.1 C:\Users\imart\Documents\Thermoflow 26\IMG\a_FAW1_Assemblies\ST\IMG_CC2P_ED_ST Ass.tfx
File Edit Options Define View Help
Edit Drawing
Edit Inputs
Flowsheets
Components
Text
Graphics
PEACE
Assemblies
Messages
Engineering Design
Multiple Runs...
Run from Excel...
Sheet 1
Add sheet
ST Assembly: Edit Inputs (Design) - STAssembly[1]
Did you know...
The inputs edited on this menu depend on whether the assembly is in 'Design' or 'Off-design' mode.
OK
Cancel
ST Main Inputs
ST Leakages
Steam Seal System
Exhaust End Design
Miscellaneous
Model Adjustments
Sealing Steam (SS)
Discharge
To TFX source
SS Flow to LPT Exhaust per LPT Path
Automatic
User-defined
0
t/h
SS Flow to Packing Exhaust per LPT Path
Automatic
User-defined
0
t/h
Sealing Steam Regulator (SSR)
Destination of excess flow from SSR
LPT exhaust
SSR makeup steam source
HPT inlet
Sealing steam regulator pressure
1,241
bar
Maximum sealing steam regulator temperature
148,9
C
Desuperheating water temperature
15
C
,366 millibar
,2838 bar
Gas D
18
1,02 233,8
bar C
t/h kJ/kg

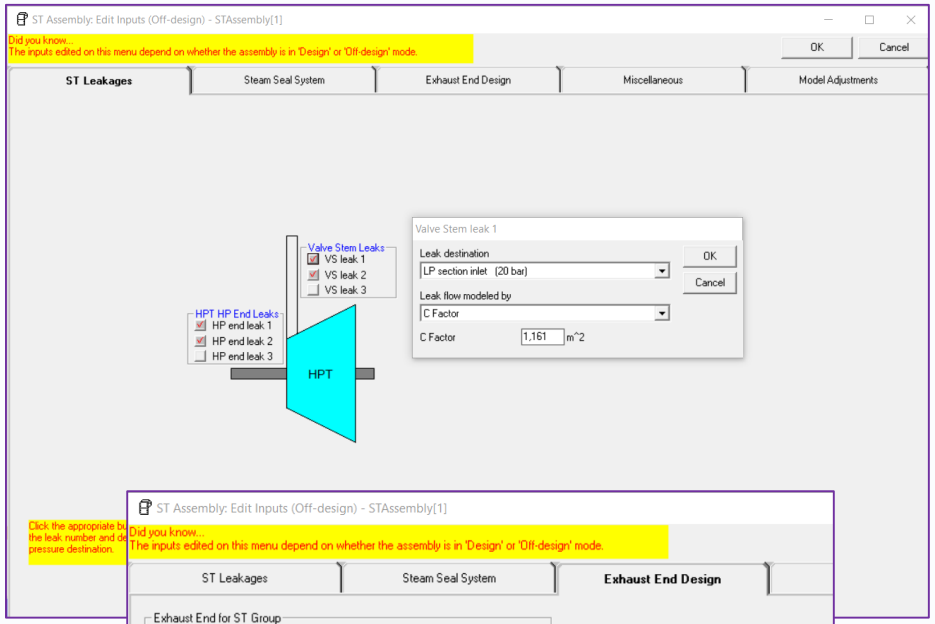
4. ST Assembly: Exhaust End

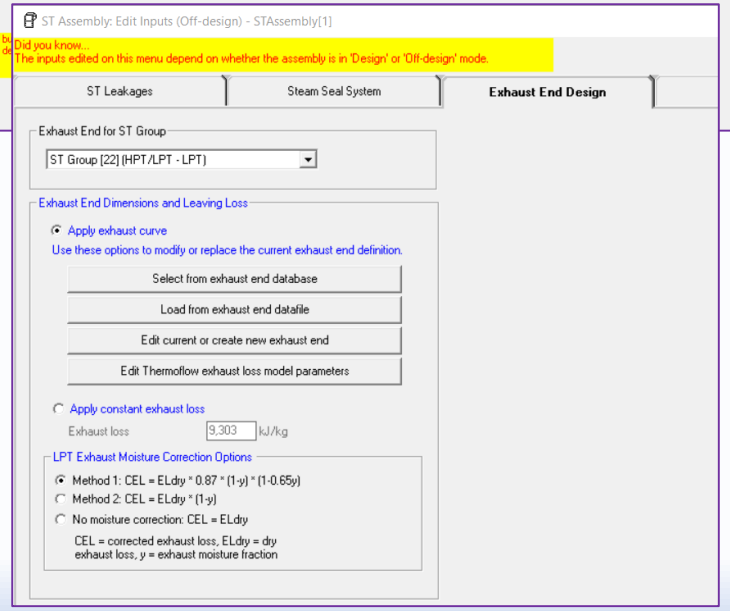


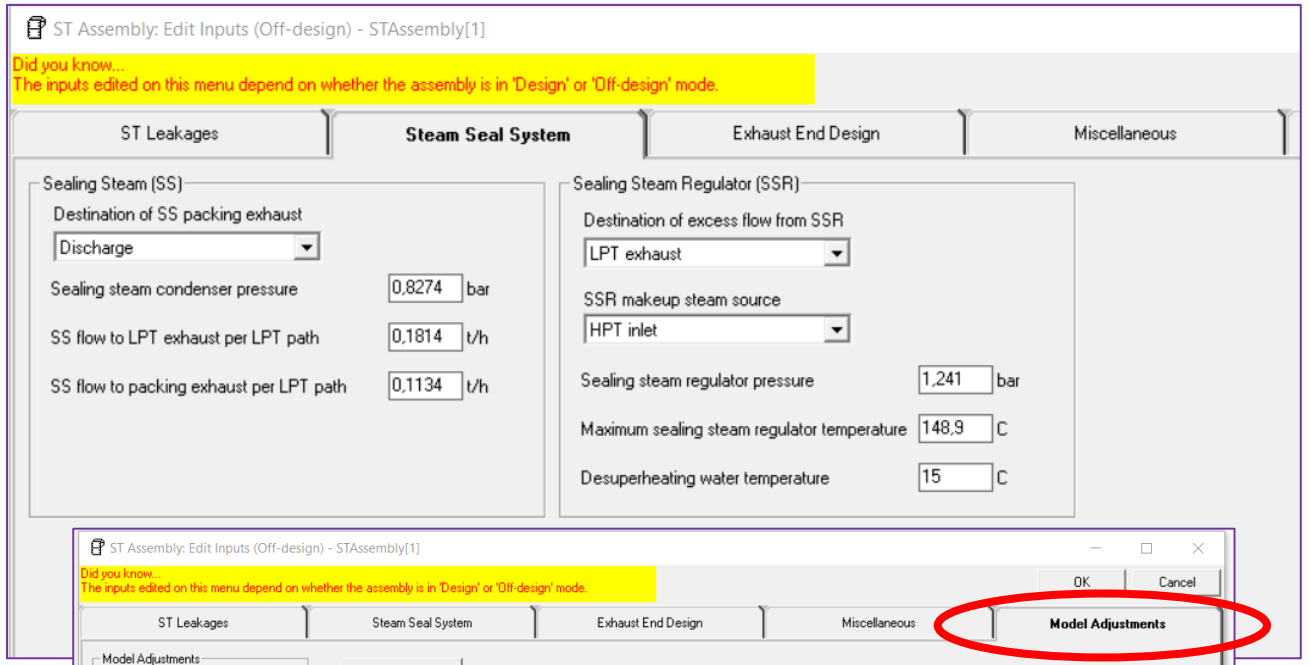
4. ST Assembly: Miscellaneous

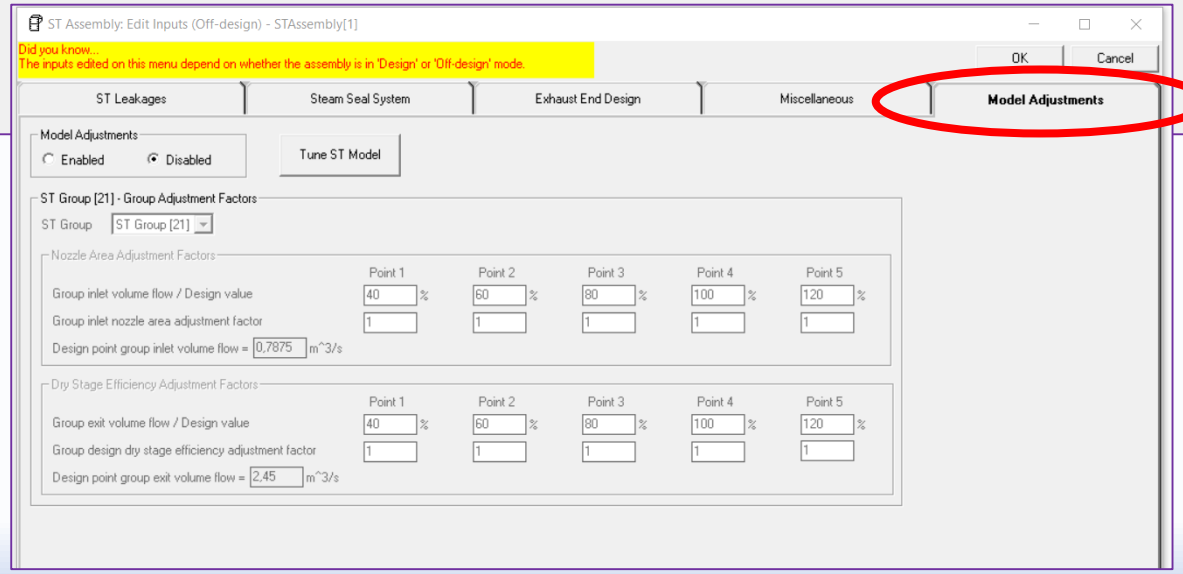


4. Steam Turbine Assembly at Off Design









Thermoflow

5. Plant Assembly

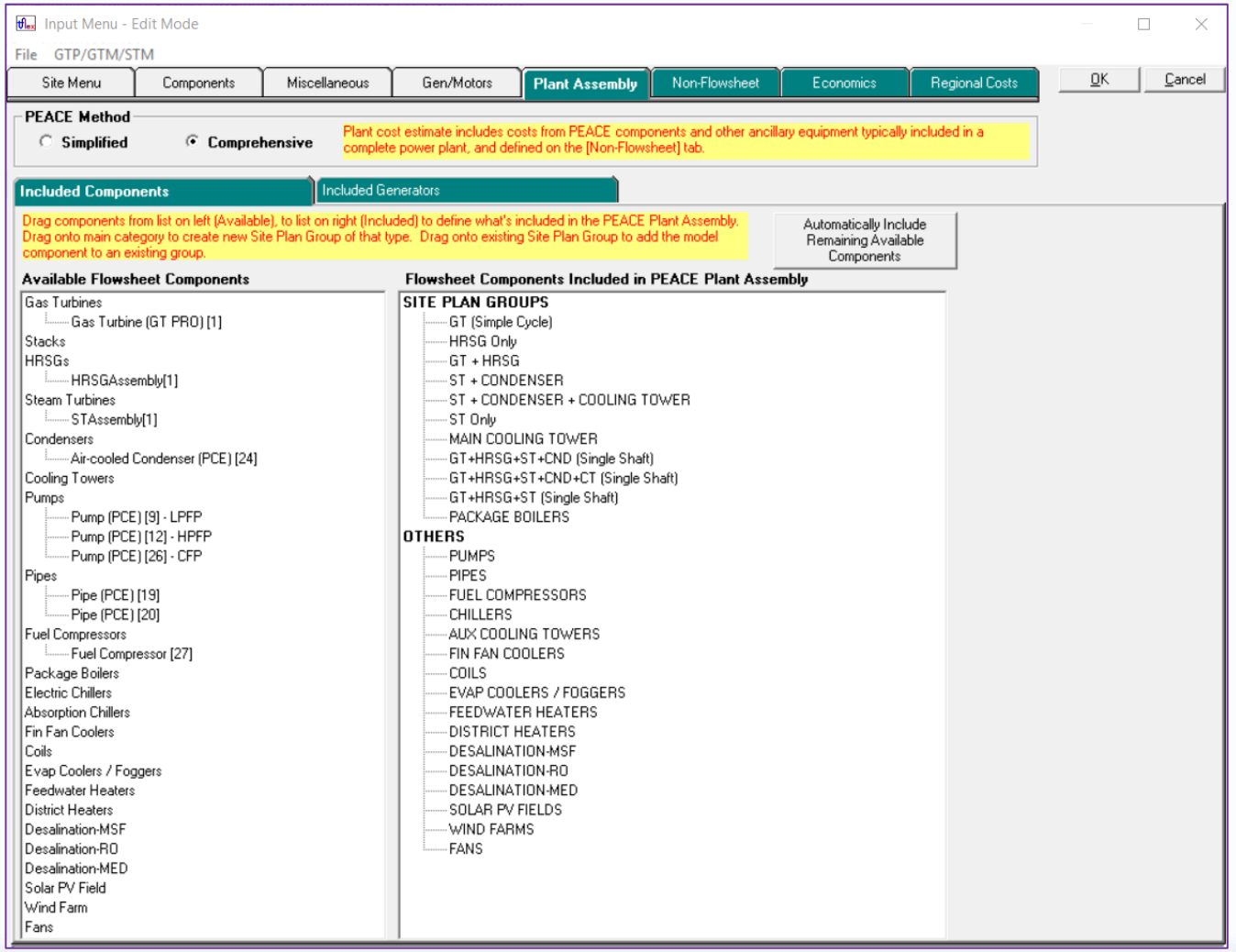
- PEACE Cost Estimation Difference:
  - App. SP.: Total Plant Cost
  - TFX-PCE: Sum of cost of Equipment (included Ass.)

- Plant Assembly Definition (GT Plants)
  - Main Components, configuration
  - Miscellaneous
  - Economic Assumptions

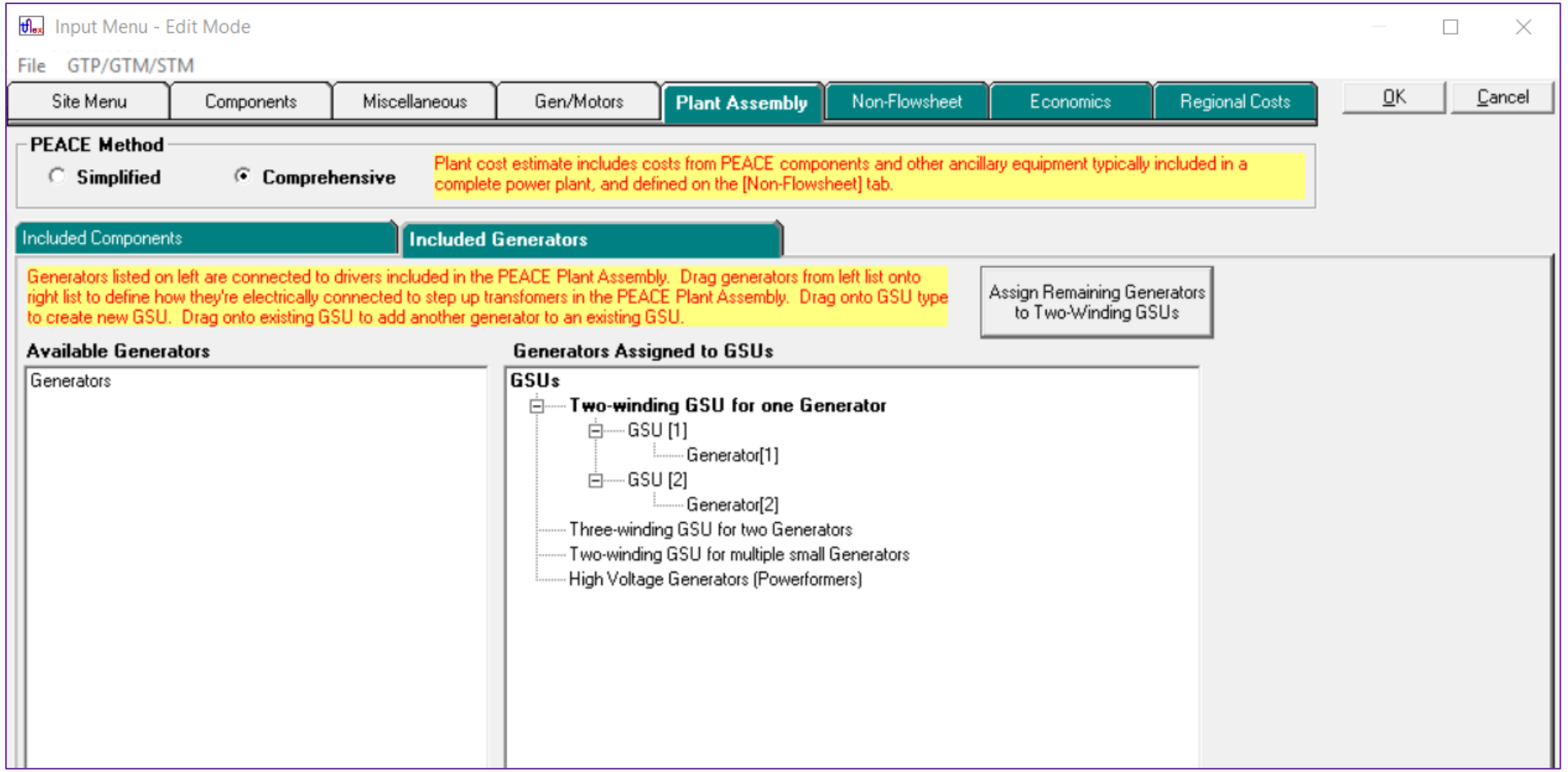
- Plant Assembly Outputs

- Plant Assembly in files imported from GTP-GTM

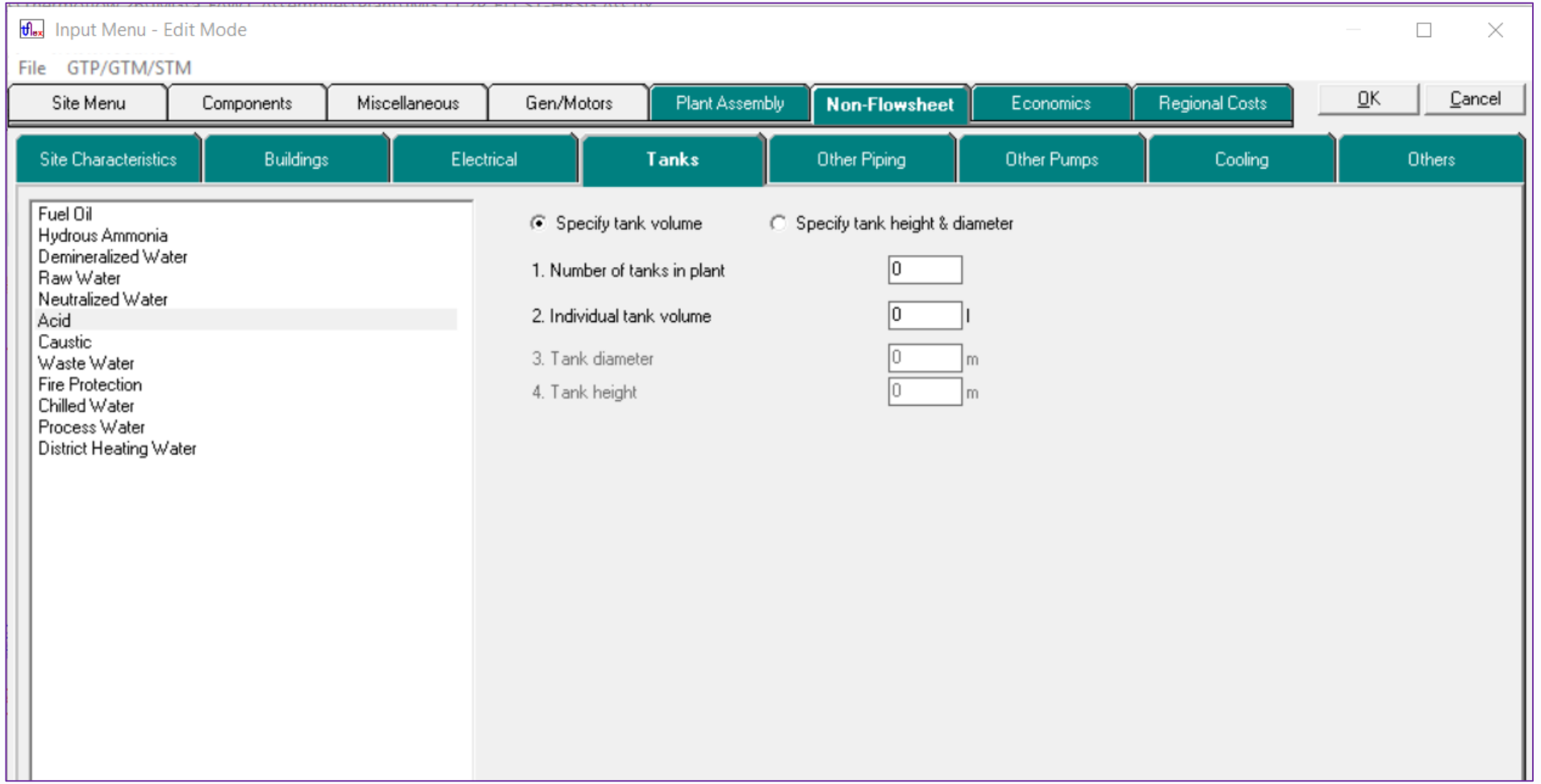
5. Plant Assembly: Definition and Inputs



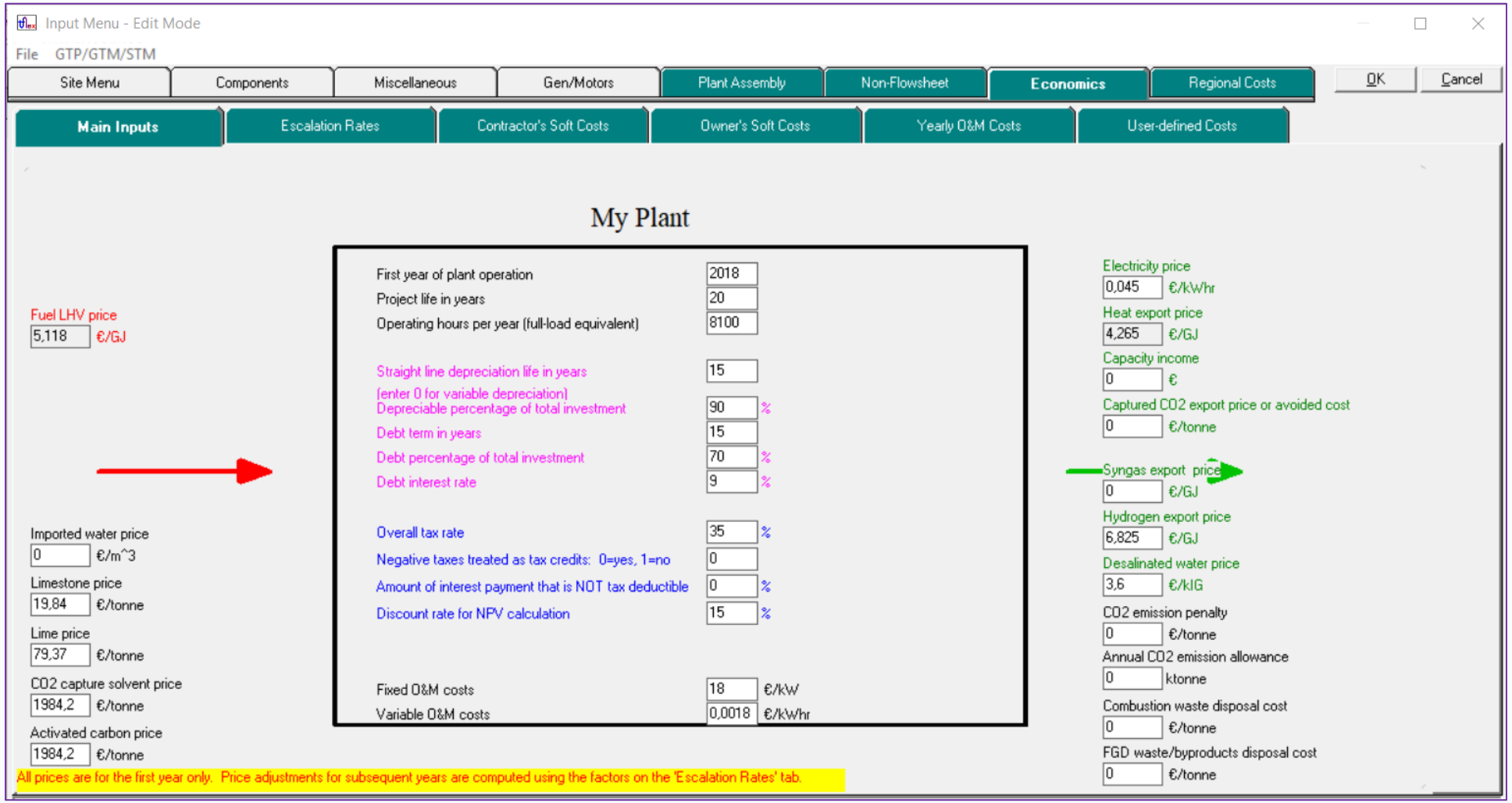
5. Plant Assembly: Definition and Inputs



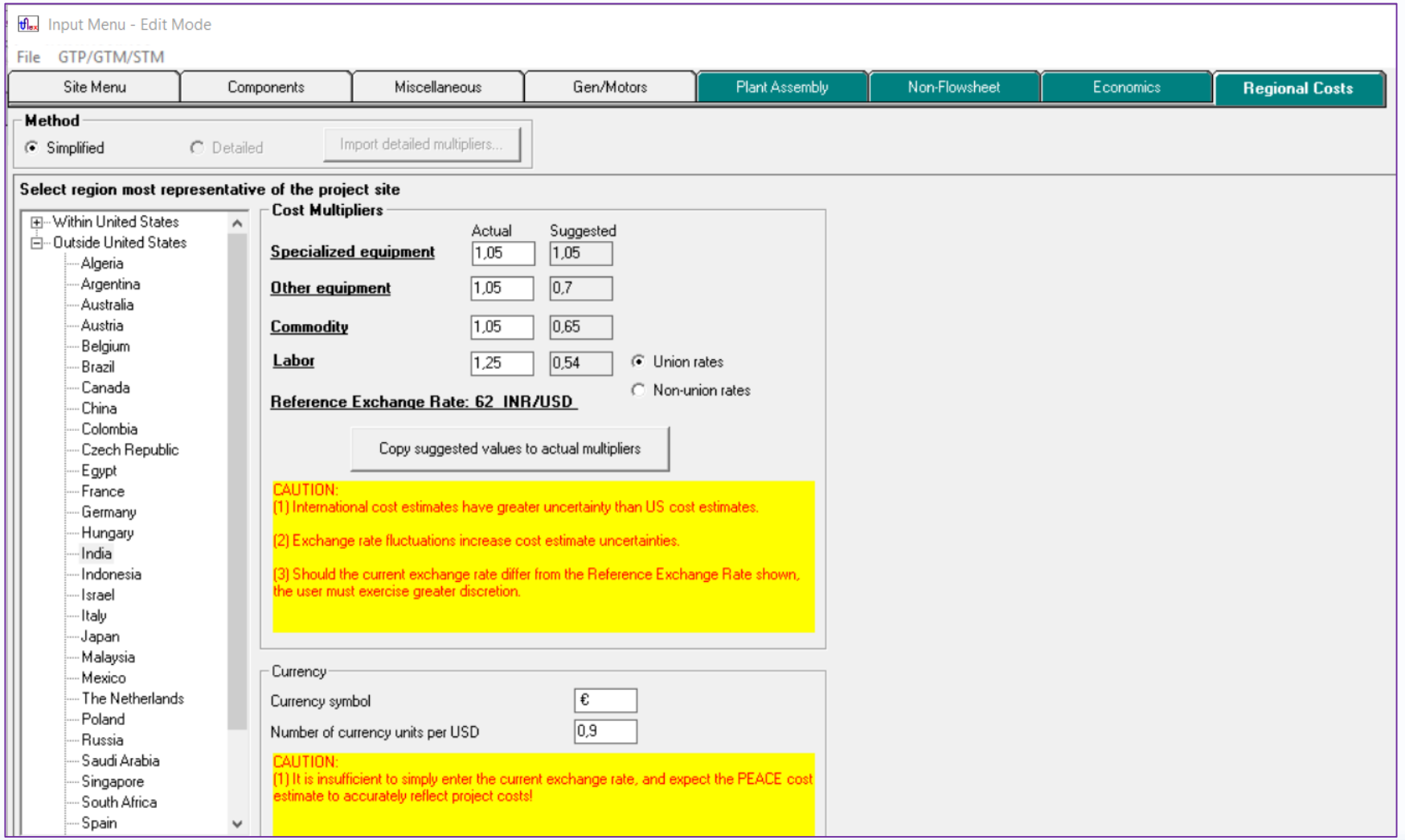
5. Plant Assembly, Non-Flowsheet Equipment



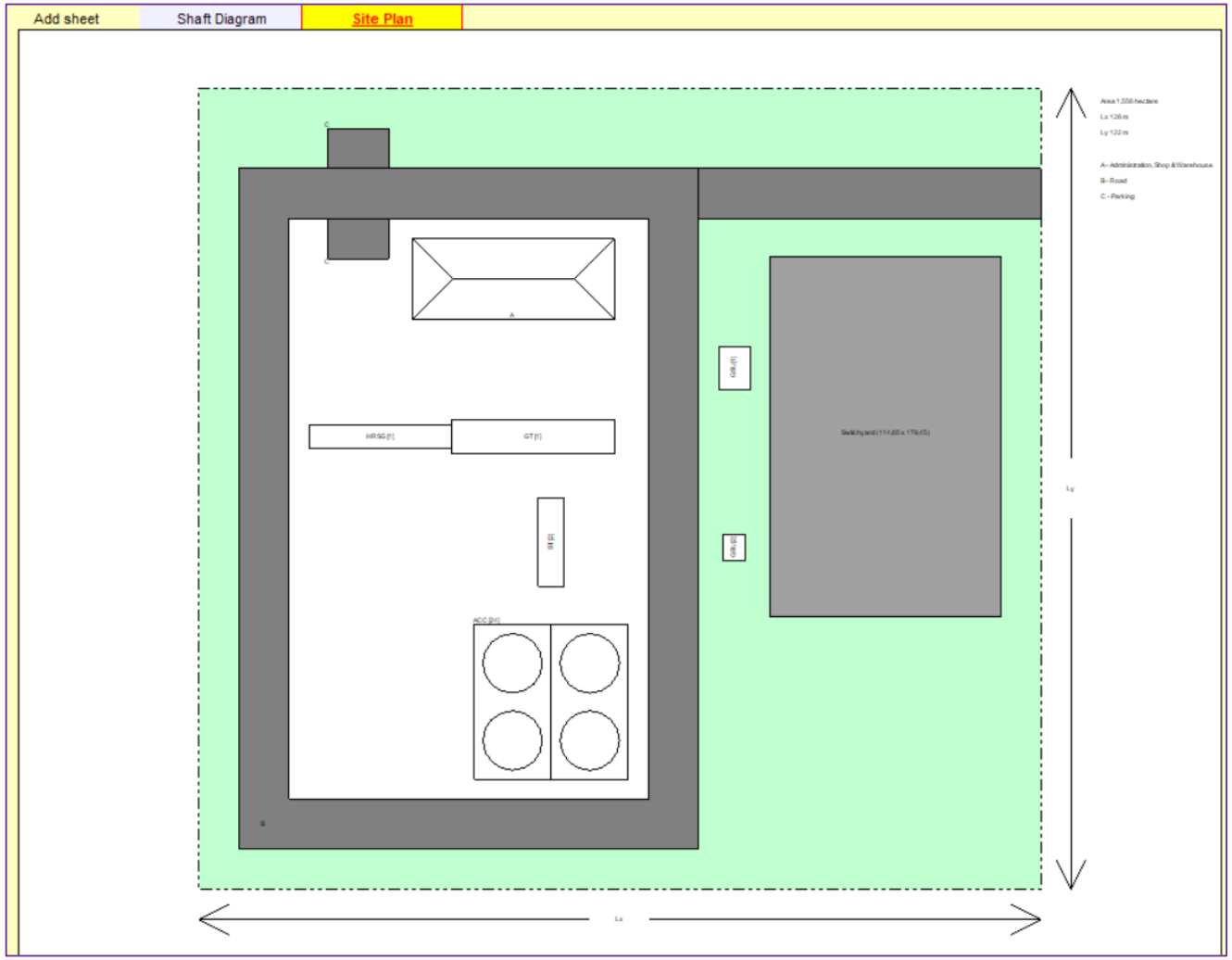
5. Plant Assembly, Economics



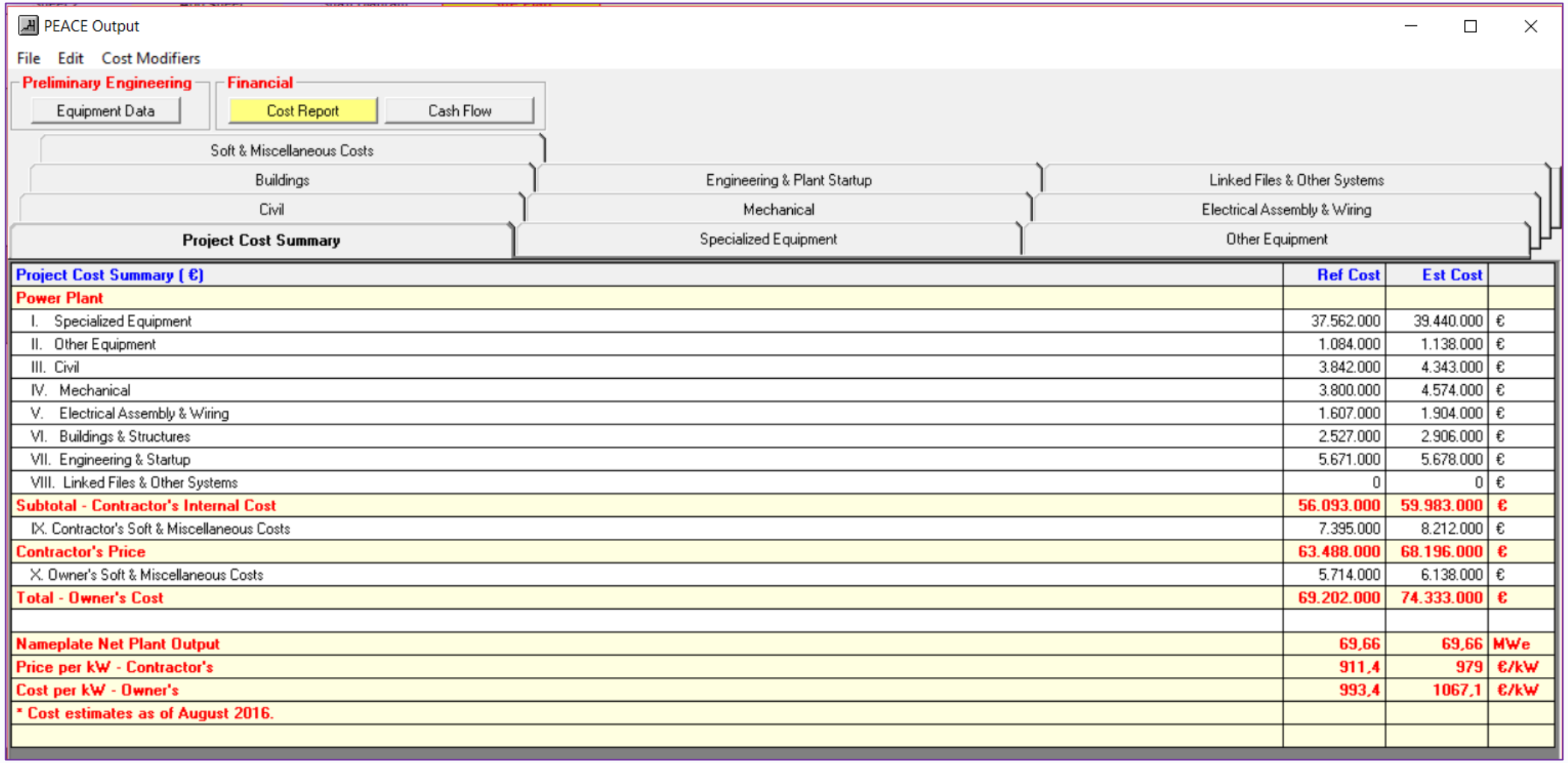
5. Plant Assembly, Regional Costs



5. Plant Assembly: Outputs

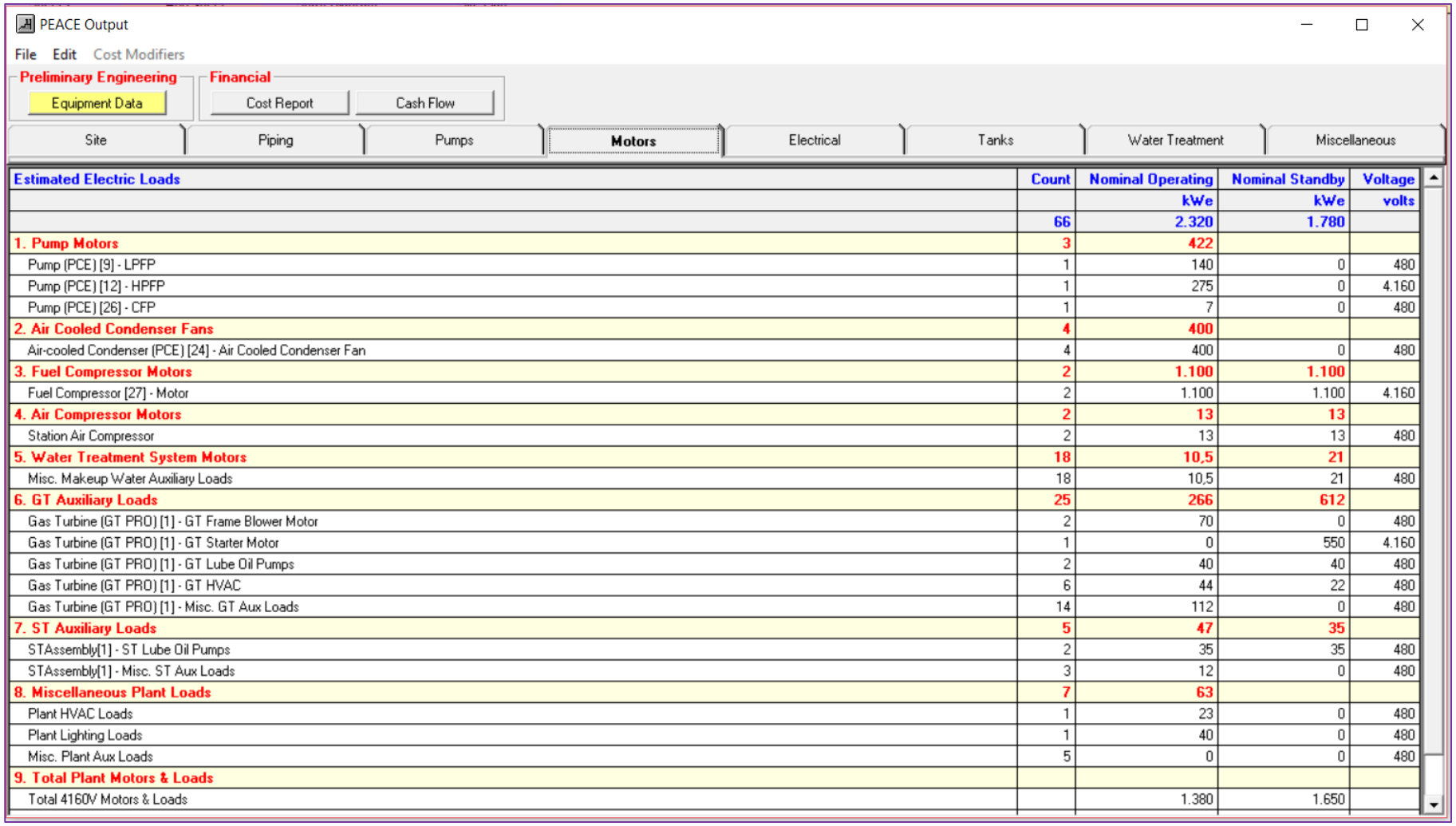


5. Plant Assembly: Outputs



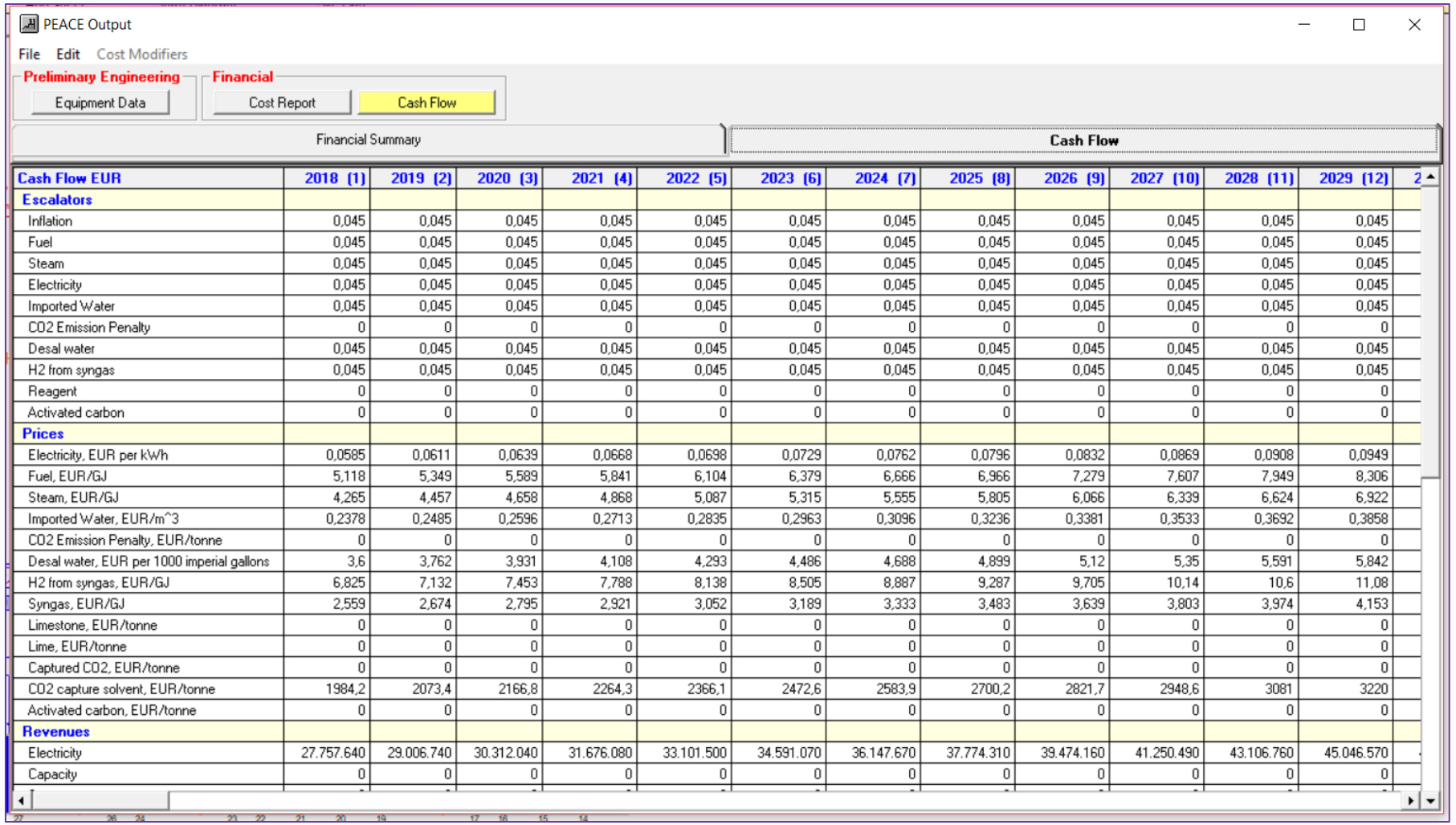
Project Cost Summary (€)	Ref Cost	Est Cost	
Power Plant			
I. Specialized Equipment	37.562.000	39.440.000	€
II. Other Equipment	1.084.000	1.138.000	€
III. Civil	3.842.000	4.343.000	€
IV. Mechanical	3.800.000	4.574.000	€
V. Electrical Assembly & Wiring	1.607.000	1.904.000	€
VI. Buildings & Structures	2.527.000	2.906.000	€
VII. Engineering & Startup	5.671.000	5.678.000	€
VIII. Linked Files & Other Systems	0	0	€
Subtotal - Contractor's Internal Cost	**56.093.000**	**59.983.000**	**€**
IX. Contractor's Soft & Miscellaneous Costs	7.395.000	8.212.000	€
Contractor's Price	**63.488.000**	**68.196.000**	**€**
X. Owner's Soft & Miscellaneous Costs	5.714.000	6.138.000	€
Total - Owner's Cost	**69.202.000**	**74.333.000**	**€**
Nameplate Net Plant Output	**69,66**	**69,66**	**MWe**
Price per kW - Contractor's	**911,4**	**979**	**€/kW**
Cost per kW - Owner's	**993,4**	**1067,1**	**€/kW**
*** Cost estimates as of August 2016.**			

5. Plant Assembly: Outputs



Estimated Electric Loads	Count	Nominal Operating kWe	Nominal Standby kWe	Voltage volts
	66	2.320	1.780	
1. Pump Motors	**3**	**422**		
Pump (PCE) [9] - LPFP	1	140	0	480
Pump (PCE) [12] - HPFP	1	275	0	4.160
Pump (PCE) [26] - CFP	1	7	0	480
2. Air Cooled Condenser Fans	**4**	**400**		
Air-cooled Condenser (PCE) [24] - Air Cooled Condenser Fan	4	400	0	480
3. Fuel Compressor Motors	**2**	**1.100**	**1.100**	
Fuel Compressor [27] - Motor	2	1.100	1.100	4.160
4. Air Compressor Motors	**2**	**13**	**13**	
Station Air Compressor	2	13	13	480
5. Water Treatment System Motors	**18**	**10,5**	**21**	
Misc. Makeup Water Auxiliary Loads	18	10,5	21	480
6. GT Auxiliary Loads	**25**	**266**	**612**	
Gas Turbine (GT PRO) [1] - GT Frame Blower Motor	2	70	0	480
Gas Turbine (GT PRO) [1] - GT Starter Motor	1	0	550	4.160
Gas Turbine (GT PRO) [1] - GT Lube Oil Pumps	2	40	40	480
Gas Turbine (GT PRO) [1] - GT HVAC	6	44	22	480
Gas Turbine (GT PRO) [1] - Misc. GT Aux Loads	14	112	0	480
7. ST Auxiliary Loads	**5**	**47**	**35**	
STAssembly[1] - ST Lube Oil Pumps	2	35	35	480
STAssembly[1] - Misc. ST Aux Loads	3	12	0	480
8. Miscellaneous Plant Loads	**7**	**63**		
Plant HVAC Loads	1	23	0	480
Plant Lighting Loads	1	40	0	480
Misc. Plant Aux Loads	5	0	0	480
9. Total Plant Motors & Loads				
Total 4160V Motors & Loads		1.380	1.650	

5. Plant Assembly: Outputs



Cash Flow EUR	2018 (1)	2019 (2)	2020 (3)	2021 (4)	2022 (5)	2023 (6)	2024 (7)	2025 (8)	2026 (9)	2027 (10)	2028 (11)	2029 (12)
Escalators												
Inflation	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
Fuel	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
Steam	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
Electricity	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
Imported Water	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
CO2 Emission Penalty	0	0	0	0	0	0	0	0	0	0	0	0
Desal water	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
H2 from syngas	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045	0,045
Reagent	0	0	0	0	0	0	0	0	0	0	0	0
Activated carbon	0	0	0	0	0	0	0	0	0	0	0	0
Prices												
Electricity, EUR per kWh	0,0585	0,0611	0,0639	0,0668	0,0698	0,0729	0,0762	0,0796	0,0832	0,0869	0,0908	0,0949
Fuel, EUR/GJ	5,118	5,349	5,589	5,841	6,104	6,379	6,666	6,966	7,279	7,607	7,949	8,306
Steam, EUR/GJ	4,265	4,457	4,658	4,868	5,087	5,315	5,555	5,805	6,066	6,339	6,624	6,922
Imported Water, EUR/m^3	0,2378	0,2485	0,2596	0,2713	0,2835	0,2963	0,3096	0,3236	0,3381	0,3533	0,3692	0,3858
CO2 Emission Penalty, EUR/tonne	0	0	0	0	0	0	0	0	0	0	0	0
Desal water, EUR per 1000 imperial gallons	3,6	3,762	3,931	4,108	4,293	4,486	4,688	4,899	5,12	5,35	5,591	5,842
H2 from syngas, EUR/GJ	6,825	7,132	7,453	7,788	8,138	8,505	8,887	9,287	9,705	10,14	10,6	11,08
Syngas, EUR/GJ	2,559	2,674	2,795	2,921	3,052	3,189	3,333	3,483	3,639	3,803	3,974	4,153
Limestone, EUR/tonne	0	0	0	0	0	0	0	0	0	0	0	0
Lime, EUR/tonne	0	0	0	0	0	0	0	0	0	0	0	0
Captured CO2, EUR/tonne	0	0	0	0	0	0	0	0	0	0	0	0
CO2 capture solvent, EUR/tonne	1984,2	2073,4	2166,8	2264,3	2366,1	2472,6	2583,9	2700,2	2821,7	2948,6	3081	3220
Activated carbon, EUR/tonne	0	0	0	0	0	0	0	0	0	0	0	0
Revenues												
Electricity	27.757.640	29.006.740	30.312.040	31.676.080	33.101.500	34.591.070	36.147.670	37.774.310	39.474.160	41.250.490	43.106.760	45.046.570
Capacity	0	0	0	0	0	0	0	0	0	0	0	0