



Welcome!

Webinar #8. Combining THERMOFLEX &
Application-Specific programs

August 3, 2017

The webinar will be starting on time (10:00 EDT)

Host: Meritt Elmasri (US office)

Presenter: Evgeny Zakharenkov

Agenda

- Introduction
- Links: THERMOFLEX & Application-Specific programs
- Importing files into THERMOFLEX
- Merging THERMOFLEX files

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 Product Line

Application Specific

Repowering Steam Cycles

- ☑ RE-MASTER

Gas Turbine Combined Cycles

- ☑ PDE, webPDE
- ☑ GT PRO
- ☑ GT MASTER

Conventional Steam Cycles

- ☑ STEAM PRO
- ☑ STEAM MASTER

Fully Flexible

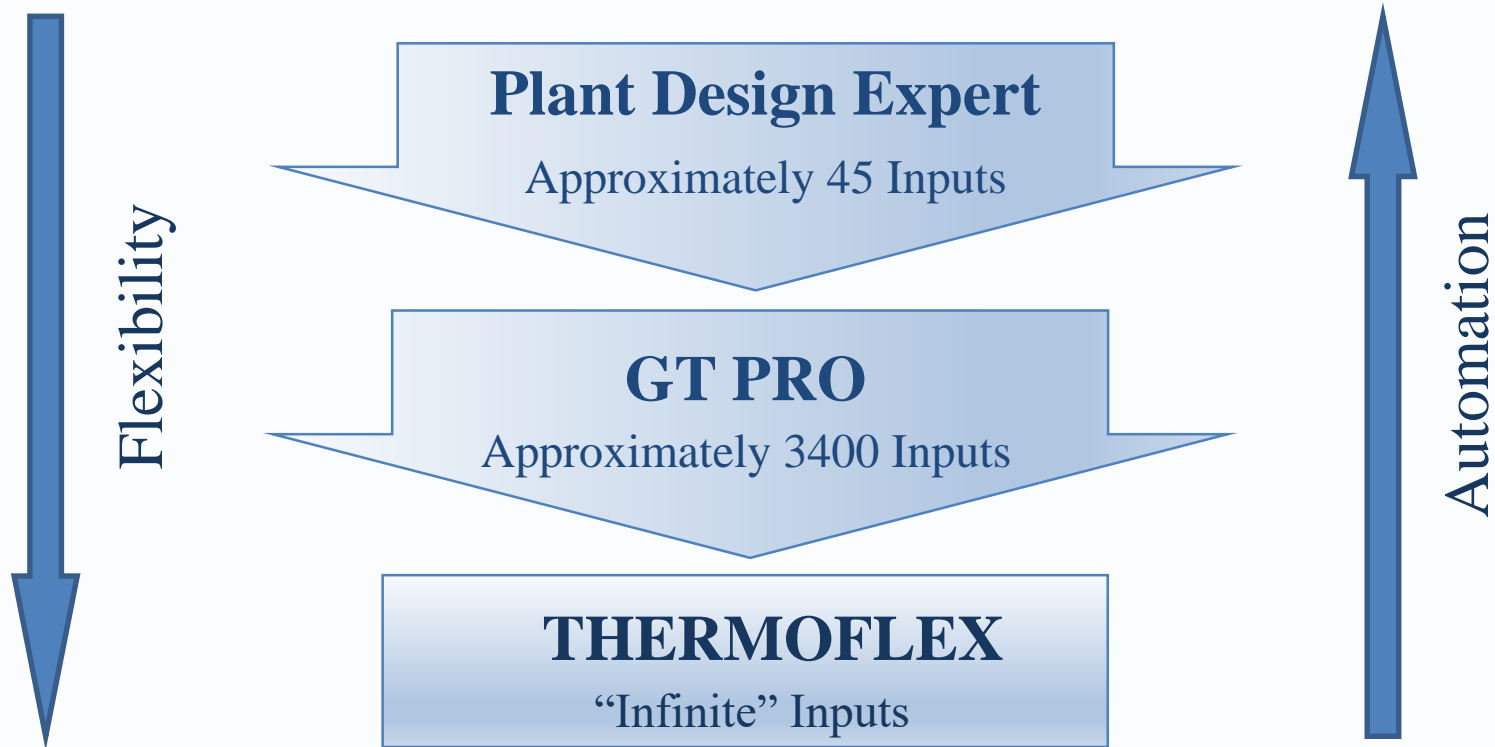
General Thermal Cycles - Emphasis on Power Plants

- ☑ ThermoFlex

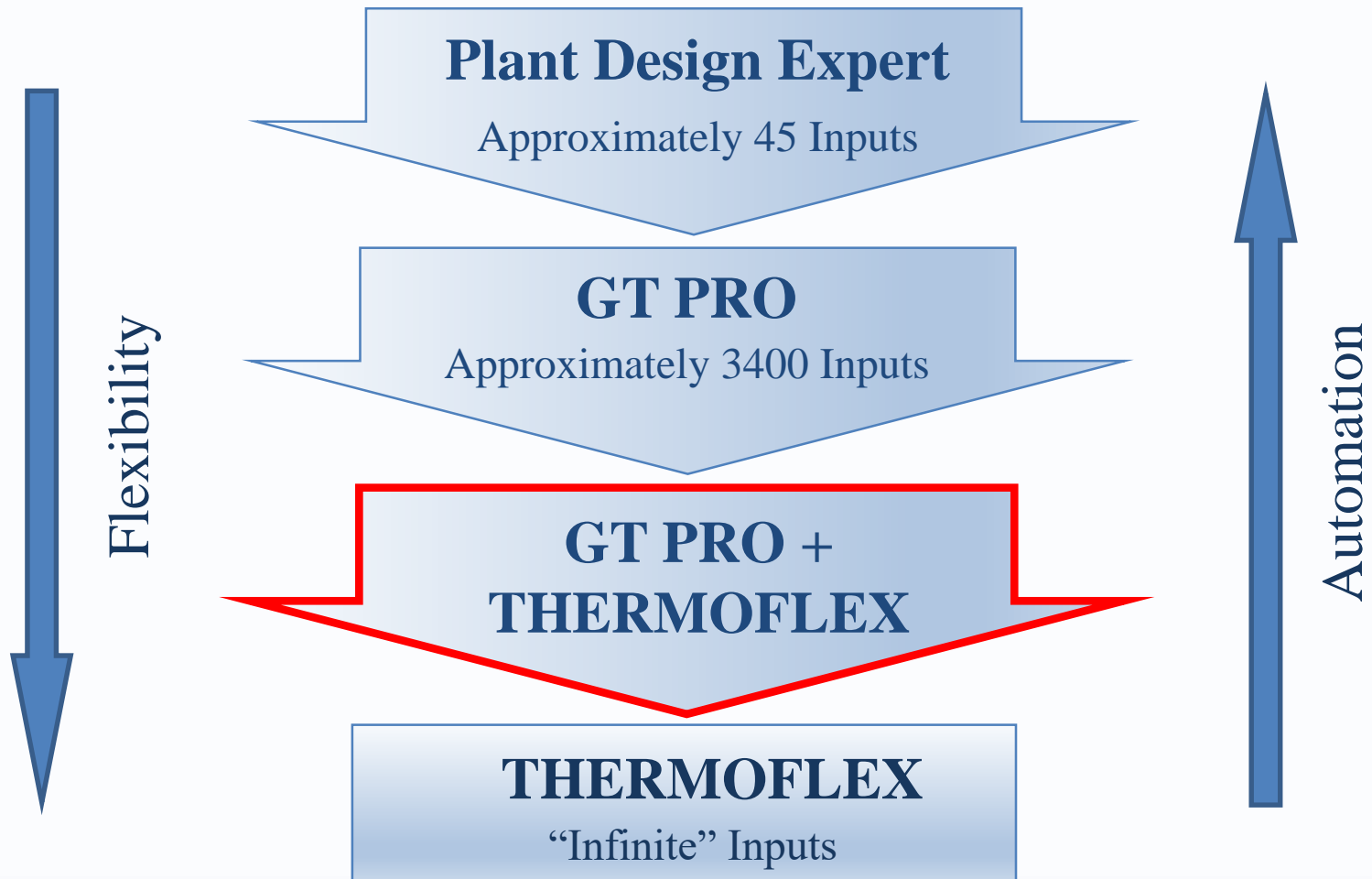
Technical Economic

- ☑ PEACE

Automation / Flexibility



Automation / Flexibility



Links: THERMOFLEX & Application-Specific programs

- Linking a THERMOFLEX model with one or more of the Application-Specific models (GT PRO, GT MASTER, and STEAM MASTER), creates a hybrid model
- Combining programs allows to model more complex and/or non-standard cycles
- Saving model setup time with fast and automated Application-Specific programs

Hybrid Model Samples

1. GT – Reciprocating Engine plant with Absorption chiller
2. 660 MW Coal Plant – Repowering
3. Integrated Solar Combined Cycle

Plant Model 1. GT – Recip. Engines with Abs. chiller

- This sample demonstrates combined model GT cycle and two reciprocating engines with absorption chiller
- GT PRO/GT MASTER is used to model combined cycle based on Siemens SGT-800 gas turbine and back-pressure steam turbine
- THERMOFLEX – Reciprocating engines with their HRSGs, steam header, absorption chiller, cooling system and linked streams to GT MASTER

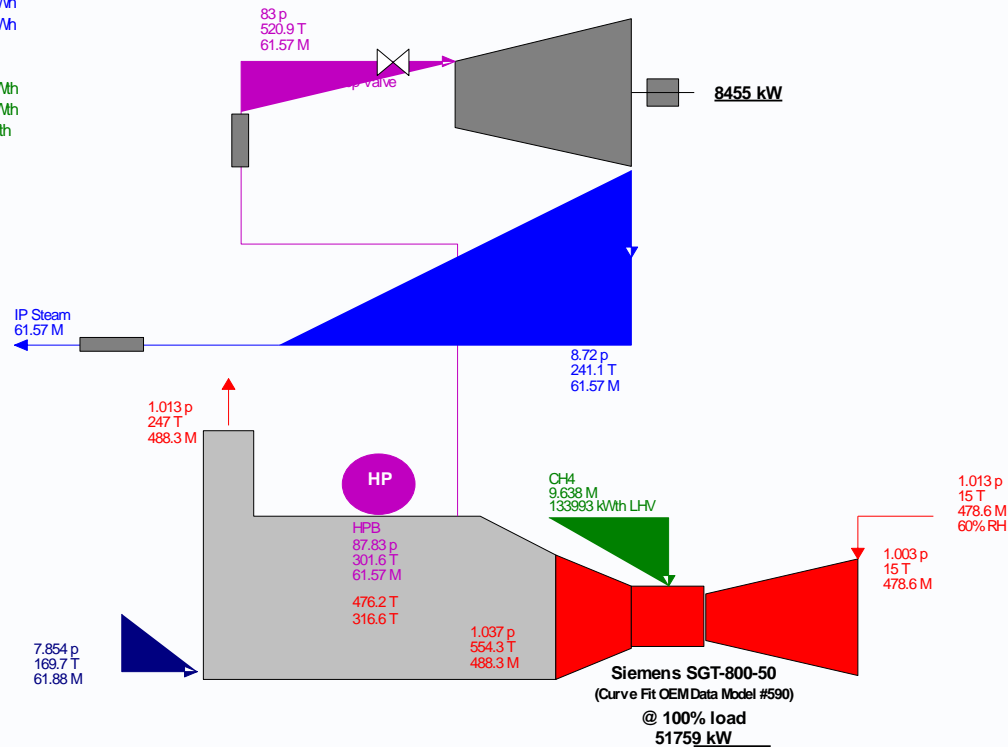
Plant Model 1. GT – Recip. Engines with Abs. chiller

GT MASTER Model results

GT MASTER 25.0 Office

Gross Power	60214 kW
Net Power	58531 kW
Aux & Losses	1663.2 kW
LHV Gross Heat Rate	8011 kJ/kWh
LHV Net Heat Rate	8241 kJ/kWh
LHV Gross Electric Eff.	44.94 %
LHV Net Electric Eff.	43.68 %
Fuel LHV Input	133993 kWth
Fuel HHV Input	148680 kWth
Net Process Heat	37715 kWth

Ambient
1,013 P
15 T
60% RH



p [bar] T [C] M [wh], Steam Properties: IAPWS-IF97
1987 10-12-2015 16:42:20 file=C:\TFLOW\25\MYFILES\GT-Recip absorption chiller.GTM

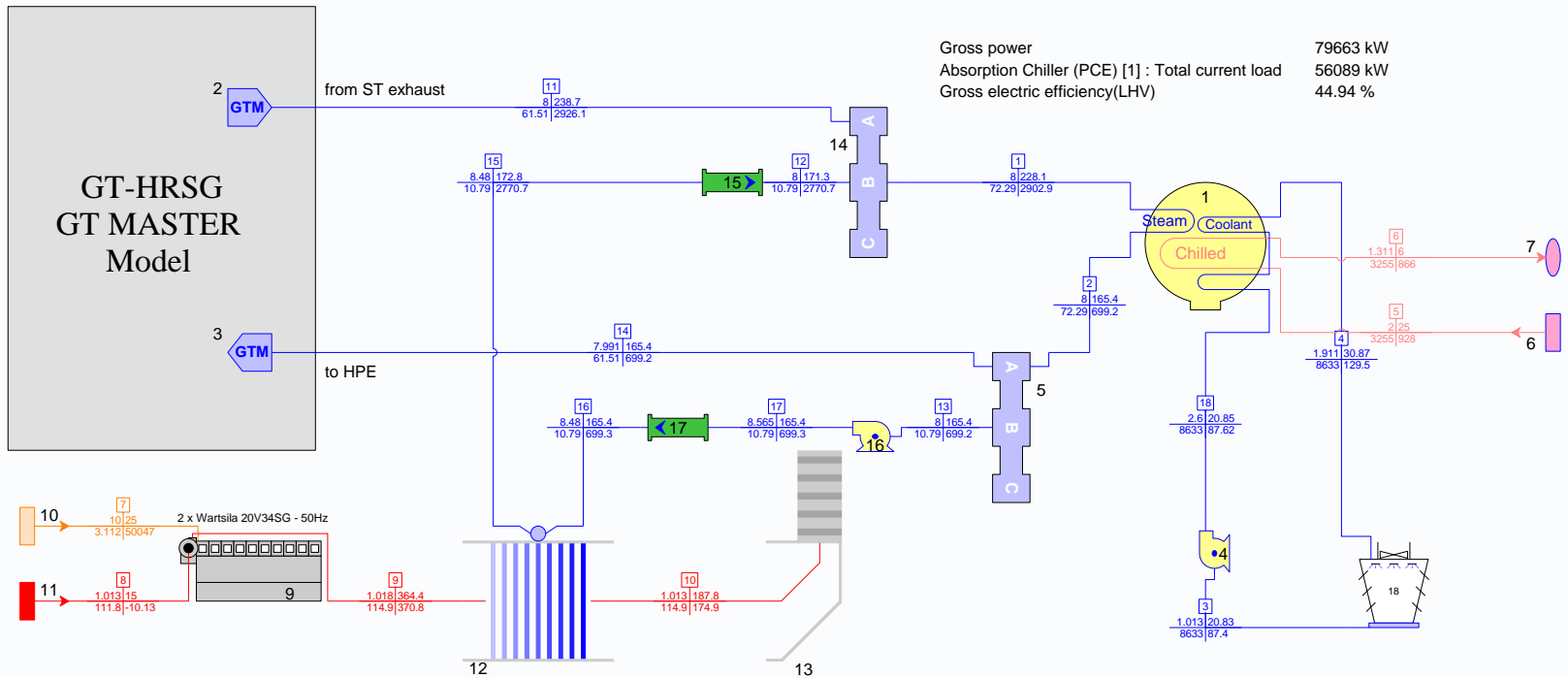
GT MASTER 25.0 Office

File: GT-Recip absorption.GTM

Plant Model 1. GT – Recip. Engines with Abs. chiller Hybrid Model

THERMOFLEX Version 25.0 Revision: September 21, 2015 Office Evgeny Zakharenkov

bar | C
t/h | kJ/kg



File: GT-Recip absorption.TFX

Plant Model 2. 660 MW Coal Plant - Repowering

- This sample demonstrates Feedwater Heater Repowering of 660MW conventional steam plant with gas turbine Hitachi H-100
- STEAM PRO/STEAM MASTER is used to model existing steam cycle
- THERMOFLEX is used to model the gas turbine, heat recovery steam generator and links to STEAM MASTER

Plant Model 2. 660 MW Coal Plant - Repowering

STEAM PRO/STEAM MASTER model description

ST Power Output: 660 MW (50 Hz)

Boiler Type: Conventional

Fuel: Coal fired

Steam Turbine Configuration: Single reheat

Steam Turbine Type: Subcritical parameters

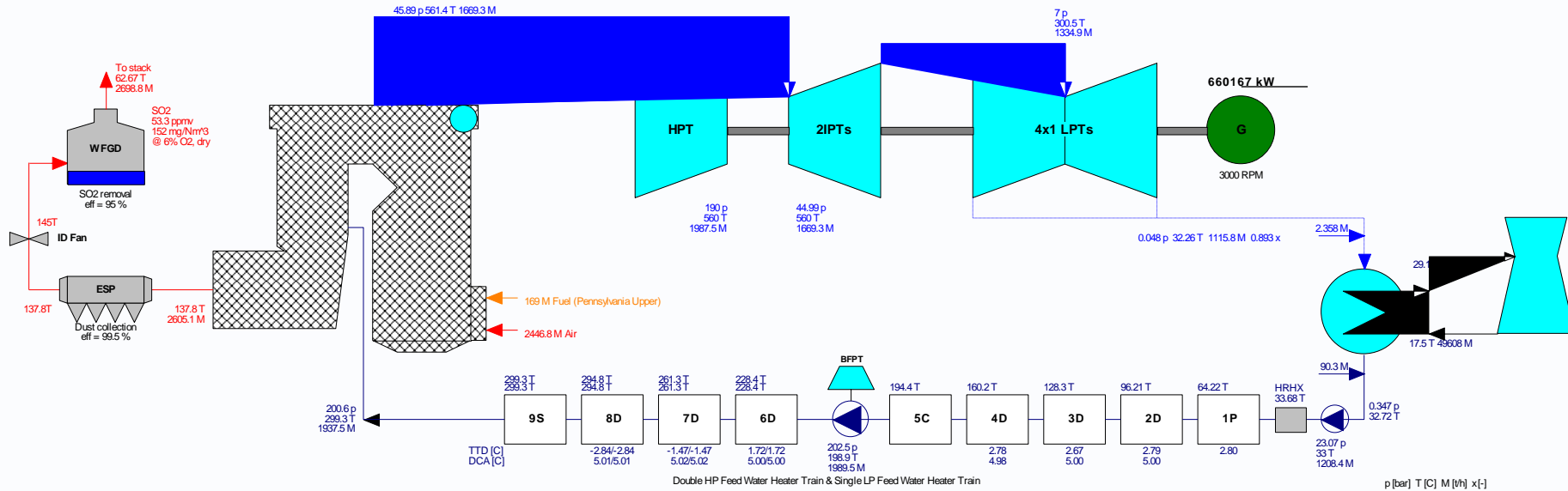
Cooling System Type: Natural draft cooling tower

Plant Model 2. 660 MW Coal Plant - Repowering

STEAM MASTER Model results

Plant gross power	660167	kW
Plant net power	629200	kW
Number of units	1	
Plant net HR (HHV)	8939	kJ/kWh
Plant net HR (LHV)	8644	kJ/kWh
Plant net eff (HHV)	40.27	%
Plant net eff (LHV)	41.65	%
Aux. & losses	30967	kW
Fuel heat input (HHV)	5624	GJ/h
Fuel heat input (LHV)	5439	GJ/h
Fuel flow	4056	t/day

Ambient
1.013 p
15 T
60% RH
10.82 T wet bulb



STEAM MASTER 25.0 Office Evgeny Zakharenkov
1987 10-09-2015 13:45:26 C:\TFLOW25\MYFILES\660 MW CONVCOAL.STM

File: 660 MW ConvCoal.GTM

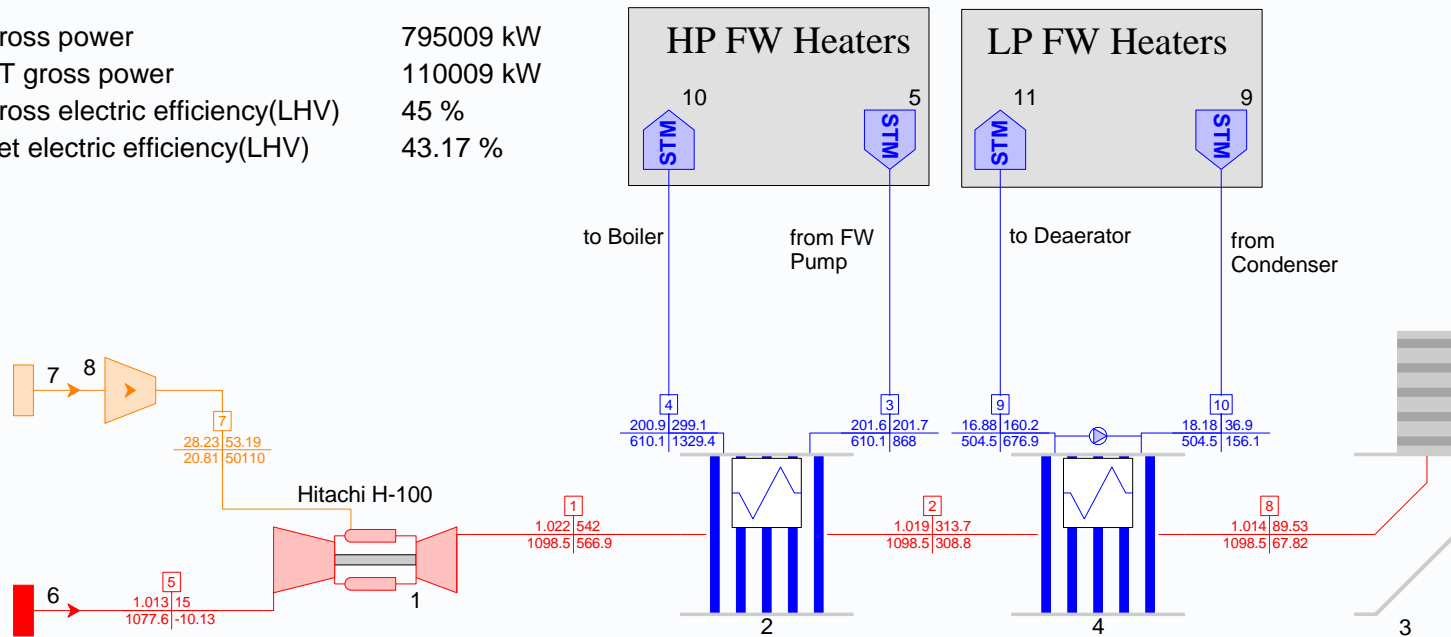
Plant Model 2. 660 MW Coal Plant - Repowering

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bar | C
t/h | kJ/kg

Gross power 795009 kW
 GT gross power 110009 kW
 Gross electric efficiency(LHV) 45 %
 Net electric efficiency(LHV) 43.17 %

Steam cycle in STEAM MASTER Feed Water Heater Bypass



File: 660MW Repowering.TFX

Plant Model 2. 660 MW Coal Plant - Repowering

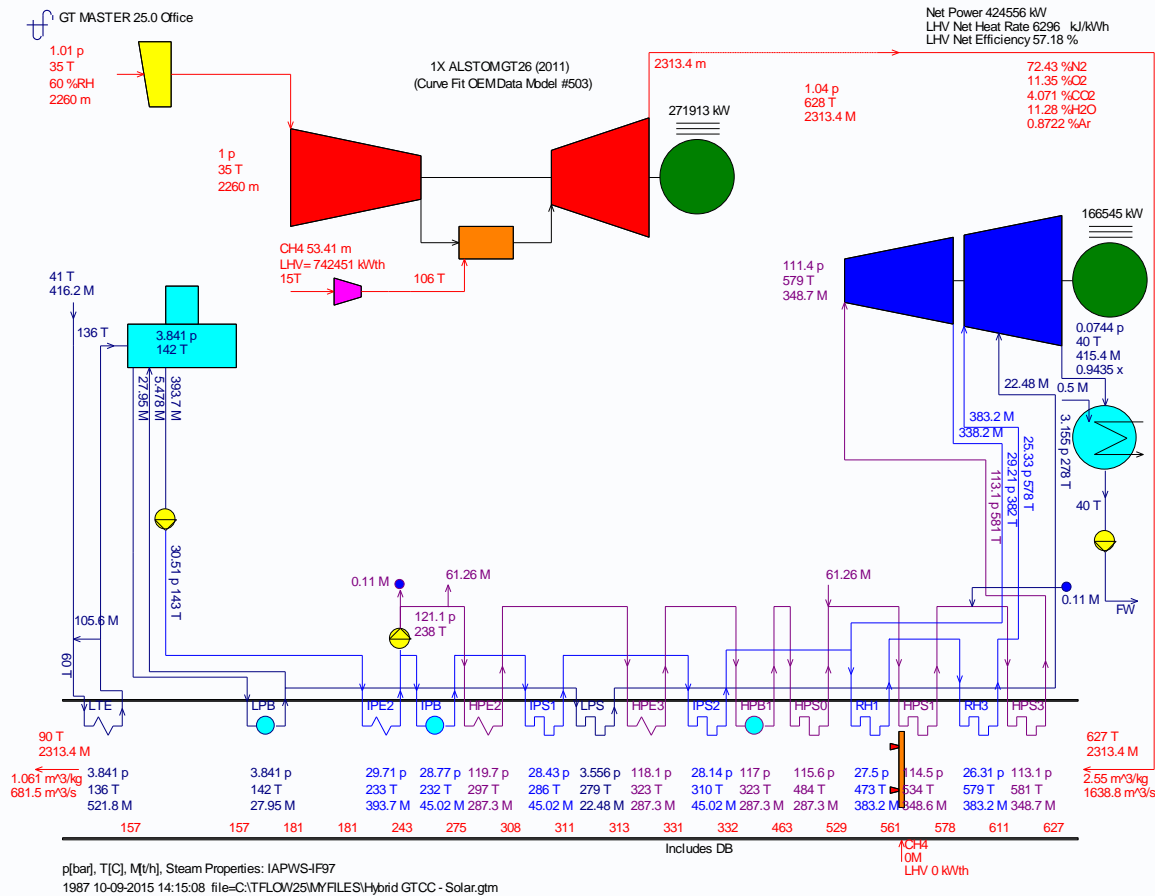
Plant model results

	Existing Plant	Repowering
Gross Power Output, MW:	660	795
- Steam Cycle	660	685
- GT Cycle	-	110
Net el. Efficiency	41.65	43.17
CO2 emission, g/kWh	776.8	694.5
CO2 reduction, g/kWh	-	82.3

Plant Model 3. Integrated Solar Combined Cycle

- This sample demonstrates Integrated Solar System Combined Cycle technology
- GT PRO/GT MASTER is used to model combined cycle based on an Ansaldo GT26 gas turbine
- THERMOFLEX – Solar tower, heat transfer fluid loop with steam generator and linked streams to GT MASTER

Plant Model 3. Integrated Solar Combined Cycle GT MASTER Model results



File: ISCC model.GTM

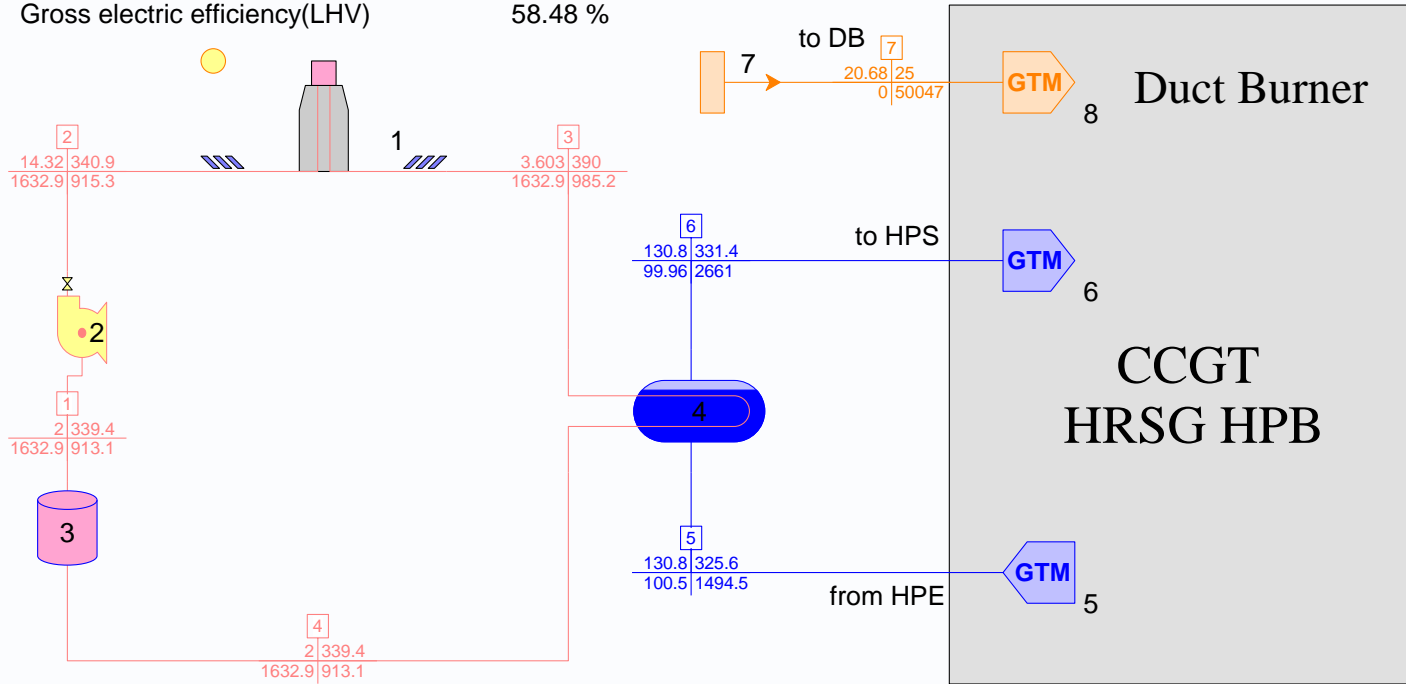
Plant Model 3. Integrated Solar Combined Cycle

Hybrid Model: Daytime operation

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bar | C
t/h | kJ/kg

Site Menu: Ambient temperature 35 C
 Site Menu: Ambient relative humidity 60 %
 Gross power 452725 kW
 Gross electric efficiency(LHV) 58.48 %



File: ISCC plant daytime.TFX

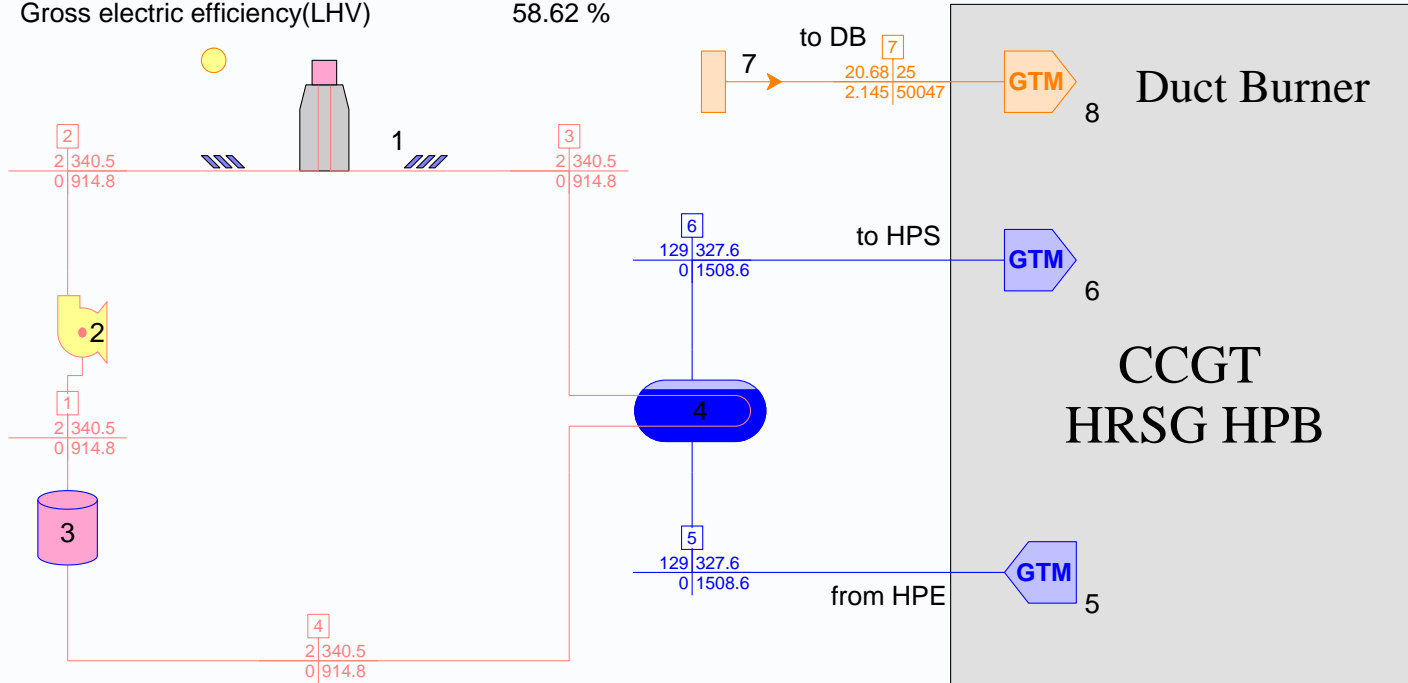
Plant Model 3. Integrated Solar Combined Cycle

Hybrid Model: Nighttime operation

© THERMOFLEX Version 25.0 Revision: September 21, 2015 Office: Evgeny Zakharenkov

bar | C
th | kJ/kg

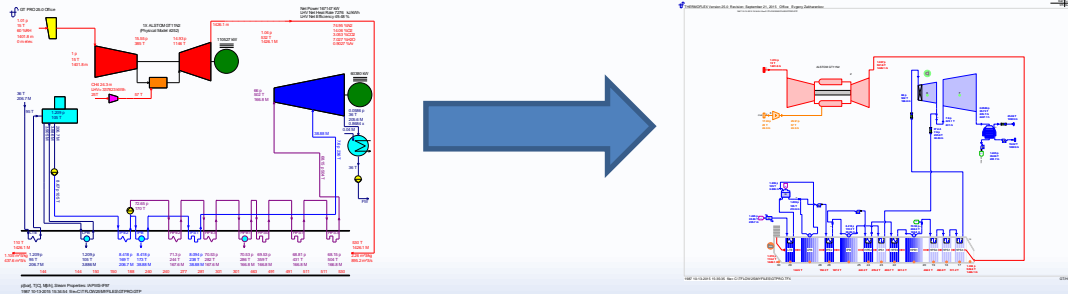
Site Menu: Ambient temperature 35 C
 Site Menu: Ambient relative humidity 60 %
 Gross power 452742 kW
 Gross electric efficiency(LHV) 58.62 %



File: ISCC plant nighttime.TFX

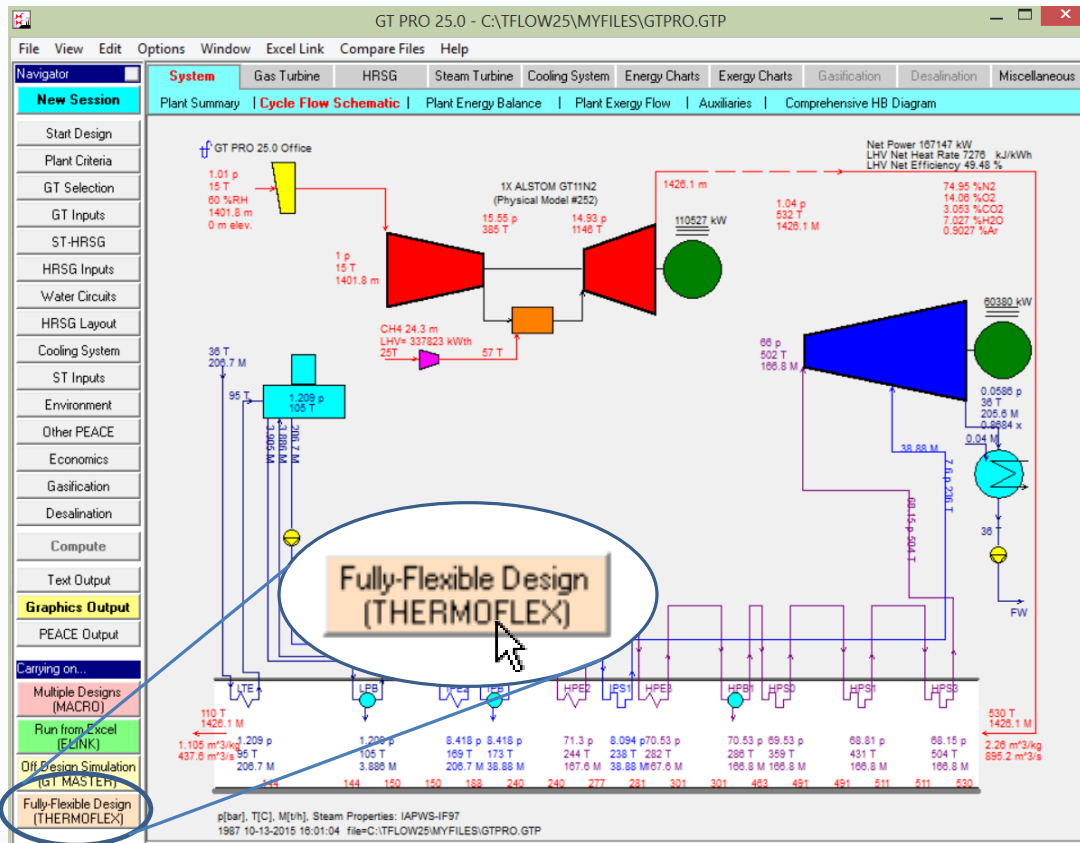
Importing into THERMOFLEX

- Importing a GT PRO/MASTER or STEAM PRO design into THERMOFLEX, lets the user build a model of a combined and steam conventional cycles or cogeneration plants quickly and professionally
- The user can import the results of GT PRO PRO/MASTER's or STEAM PRO's design to THERMOFLEX, for the ability to add unique features



Importing into THERMOFLEX

After computation just click
 “Fully-Flexible Design (THERMOFLEX)”



The screenshot shows the GT PRO 25.0 software interface. The main window displays a cycle flow schematic for a gas turbine system. Key components include a gas turbine (1X ALSTOM GT11N2), a combustion chamber (CH4), and a steam turbine (60380 kW). The schematic shows various flow streams with parameters such as pressure (p), temperature (T), and mass flow rate (M). A callout box highlights the "Fully-Flexible Design (THERMOFLEX)" option in the navigation menu. The interface also includes a menu bar (File, View, Edit, Options, Window, Excel Link, Compare Files, Help) and a toolbar with various simulation and design options.

Navigation Menu Options:

- New Session
- Start Design
- Plant Criteria
- GT Selection
- GT Inputs
- ST-HRSG
- HRSG Inputs
- Water Circuits
- HRSG Layout
- Cooling System
- ST Inputs
- Environment
- Other PEACE
- Economics
- Gasification
- Desalination
- Compute
- Text Output
- Graphics Output
- PEACE Output
- Carrying on...
- Multiple Designs (MACRO)
- Run from Excel (E-LINK)
- Off-Design Simulation (GT MASTER)
- Fully-Flexible Design (THERMOFLEX)**

System Summary:

- Net Power: 107147 kW
- LHV Net Heat Rate: 7275 kJ/kWh
- LHV Net Efficiency: 48.48 %

Plant Summary: Cycle Flow Schematic | Plant Energy Balance | Plant Exergy Flow | Auxiliaries | Comprehensive HB Diagram

GT PRO 25.0 Office

1.01 p
15 T
60 %RH
1401.8 m
0 m elev.

1X ALSTOM GT11N2
(Physical Model #252)

15.55 p
385 T

14.93 p
114.0

1426.1 m

110527 kW

1.04 p
532 T
1426.1 M

CH4 24.3 m
LHV= 337823 kWh
25 T

57 T

60380 kW

0.0568 p
30 T
205.6 M
-3.5984 x
0.04 M

38.88 M

1.100 p
100 T

38 T
200.7 M

95 T

1.209 p
105 T

30 T
200.7 M

110 T
1426.1 M

1.105 m³/s
437.5 m³/s
95 T

1.209 p
105 T

3.886 M

200.7 M

8.416 p
169 T

8.416 p
173 T

200.7 M

38.88 M

71.3 p
244 T

8.094 p
238 T

70.53 p
282 T

70.53 p
286 T

69.53 p
359 T

68.81 p
431 T

66.15 p
504 T

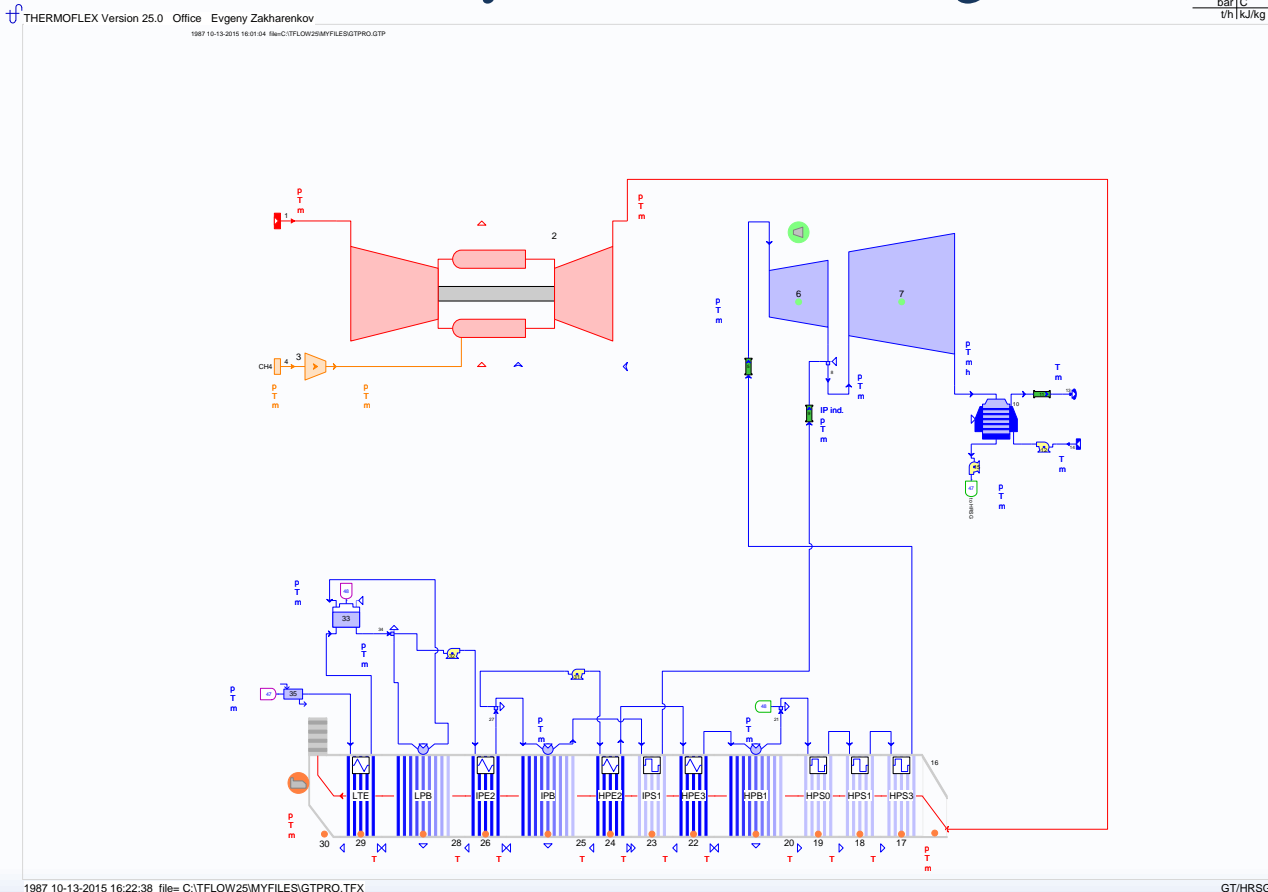
530 T
1426.1 M

2.20 m³/kg
895.2 m³/s

p[bar], T[C], M[t/h]. Steam Properties: IAPWS-IF97
 1987 10-13-2015 16:01:04 file=C:\TFLOW25\MYFILES\GTPRO.GTP

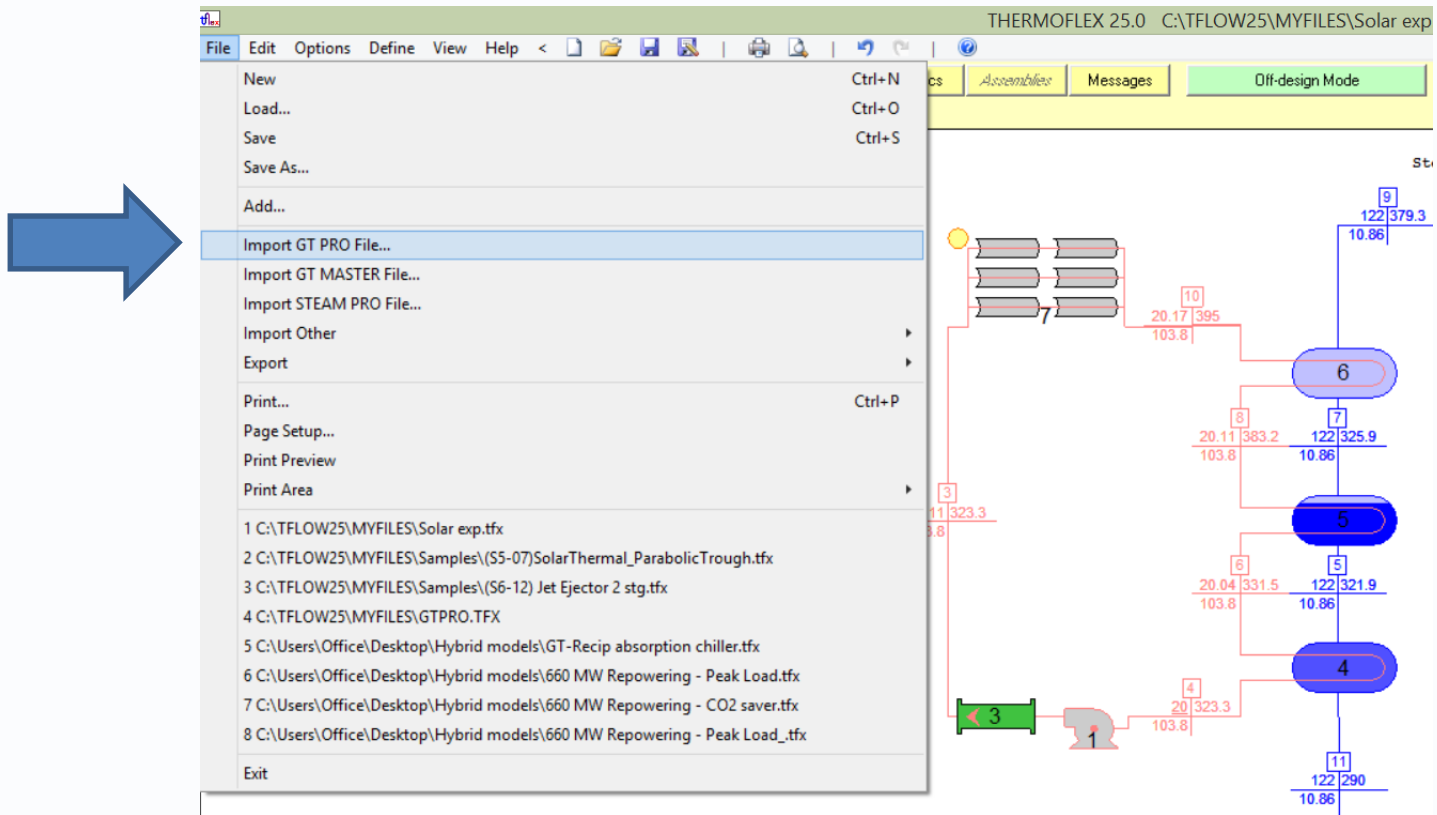
Importing into THERMOFLEX

..and THERMOFLEX will load this exact design for fully-flexible modeling



Importing into THERMOFLEX

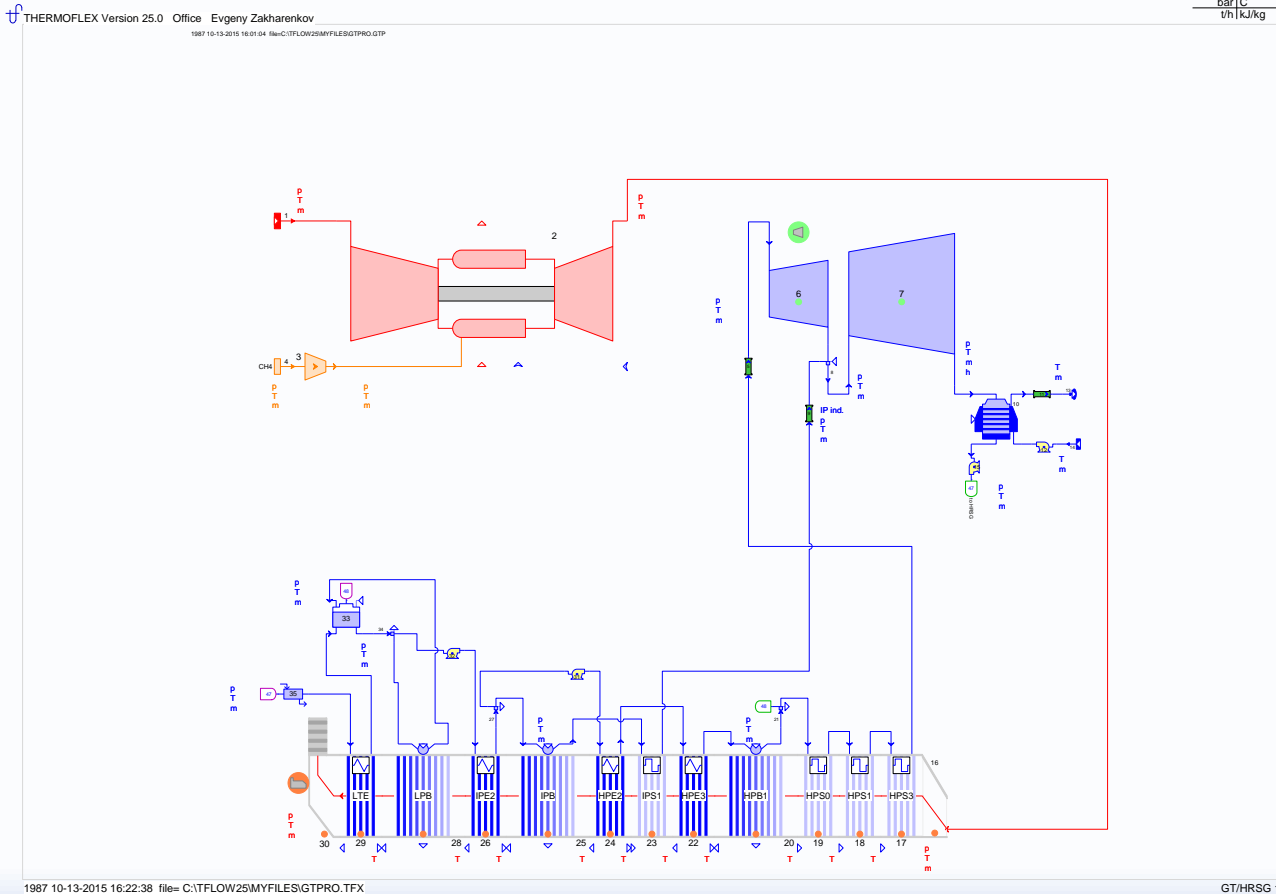
Also GT PRO/MASTER or STEAM PRO files can be imported from THERMOFLEX menu



The screenshot shows the THERMOFLEX 25.0 interface. The 'File' menu is open, and 'Import GT PRO File...' is highlighted. A blue arrow points to this menu item. The background displays a schematic diagram of a power cycle with components numbered 1 through 11. The diagram includes a pump (1), a boiler (2), a turbine (3), a condenser (4), a steam generator (5), a reheat boiler (6), a steam turbine (7), a condenser (8), a steam generator (9), a reheat boiler (10), a turbine (11), and a condenser (12). The diagram also shows a flow of fluid between these components, with various parameters like temperature and pressure indicated at different nodes.

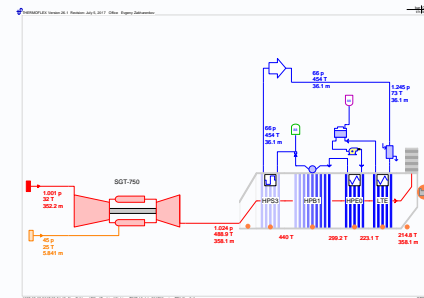
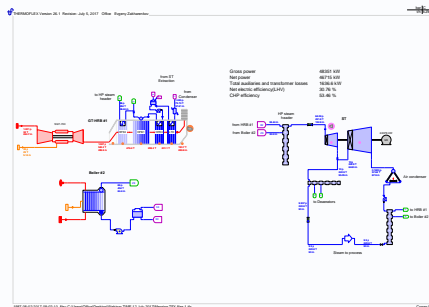
Importing into THERMOFLEX

...with the same result

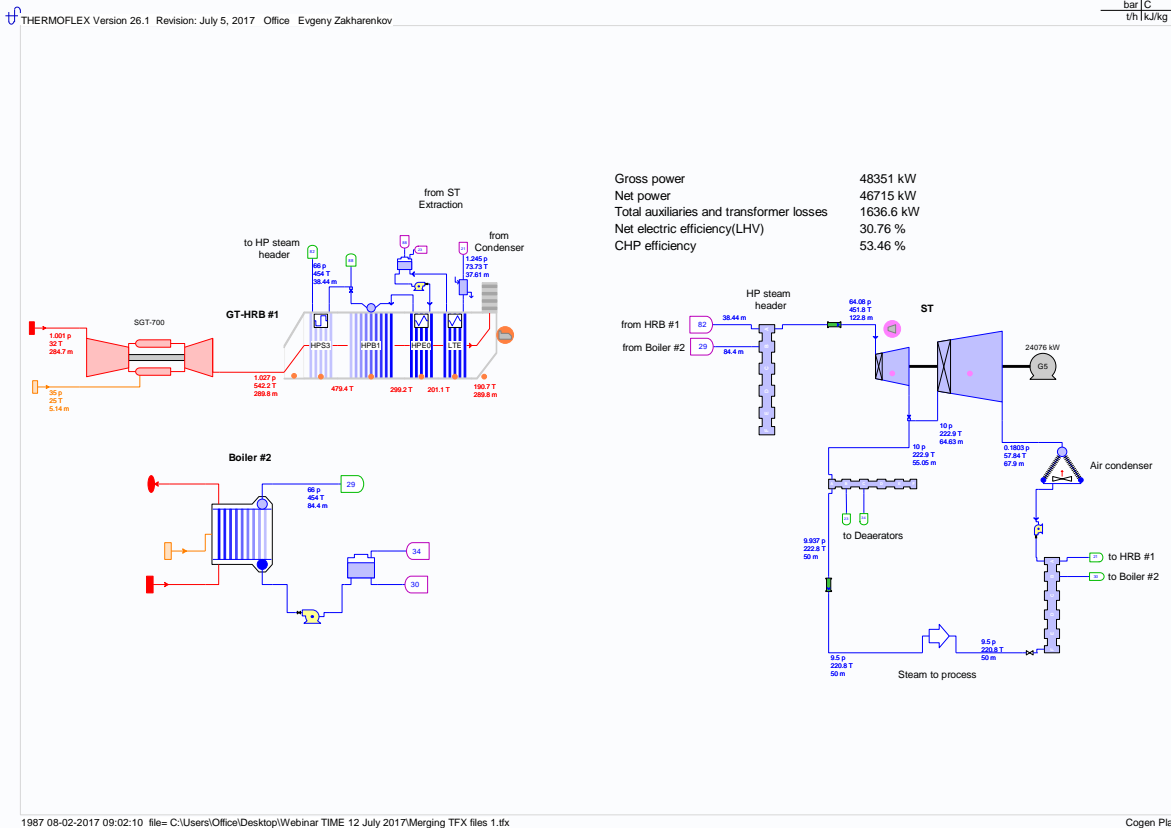


Merging THERMOFLEX files

- THERMOFLEX allows to merge two separate files into one model
- Two engineers can work on different parts of the plant and then assemble it together
- Assembling model from your own database of equipment in THERMOFLEX files



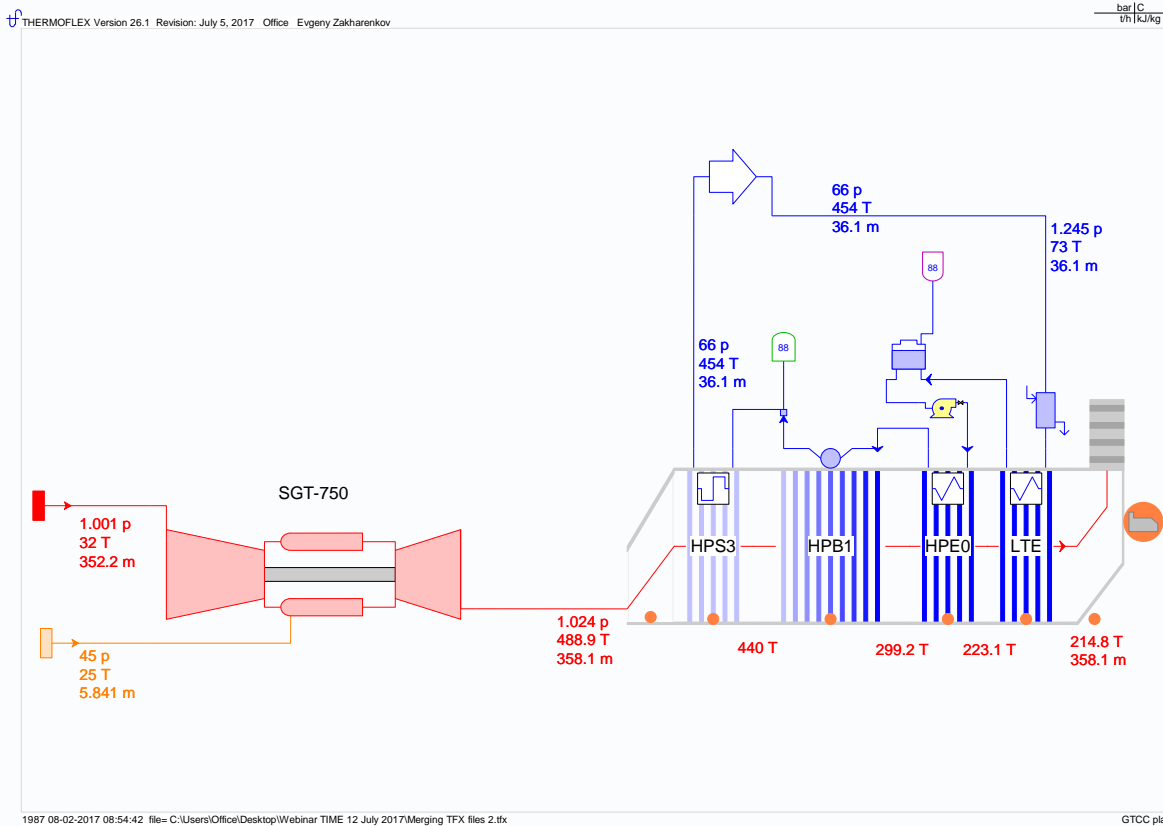
Merging THERMOFLEX files



Cogen Plant

1. Siemens SGT-700 + HRB
2. Gas-fired boiler

Merging THERMOFLEX files



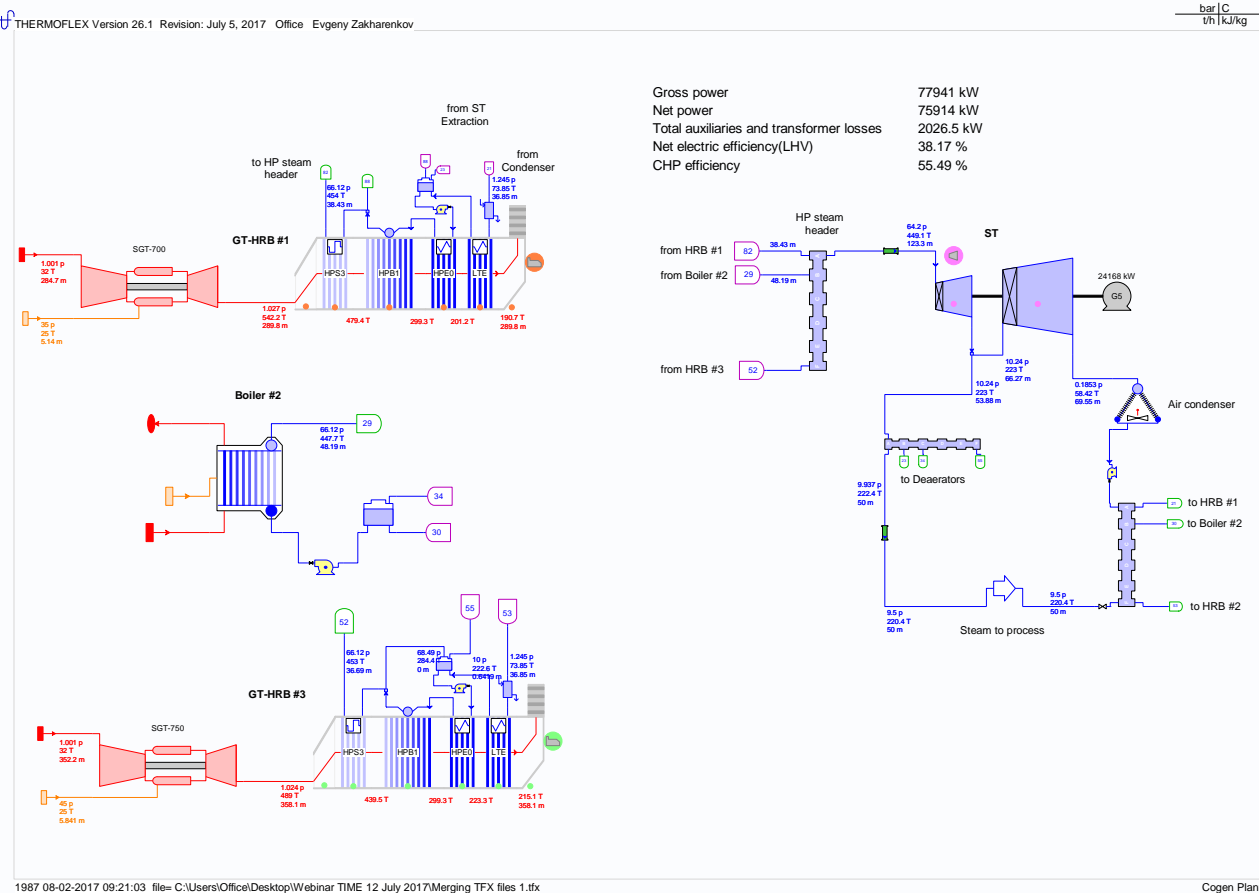
Siemens SGT-750 + HRB

These files must be computed!

Merging THERMOFLEX files

Cogen Plant

1. Siemens SGT-700 + HRB
2. Gas-fired boiler
3. Siemens SGT-750 + HRB



Q & A session

Please send your questions to the
presenter in the webinar chat!

For further questions:
zakharenkov@thermoflow.com

Thank you!