



July 25th, 2006

Dear Customer,

We are pleased to enclose a major upgrade to our software suite, Version 16, with the following highlights:

(1) GT PRO and GT MASTER have new hardware-based models for the gasifier vessel and raw syngas coolers. Additional steam sources are now available for interconnecting raw syngas coolers to the power island. New IGCC output graphics were added to better illustrate flows between the gasification plant and the power island. The gas cleanup system now includes a CO shift with supplemental steam sources from the power block. ASU model includes a more detailed model of the intercooled compressor trains.

(2) New pie charts and block diagrams are available in all PRO and MASTER programs to illustrate energy flows into and out of the plant.

(3) The text and graphic outputs were reorganized in GT PRO and GT MASTER so all results are organized by topic, reachable via a convenient two-level tab system.

(4) Text output reports retain formatting information when pasting outputs into MS Excel and MS Word in all PRO and MASTER programs.

(5) The refrigerant list in THERMOFLEX was expanded to include 39 additional materials whose properties are computed using the REFPROP software from the American National Institute of Standards and Technology.

(6) THERMOFLEX includes new component models for flue gas handling and treatment including flyash removal using electrostatic precipitation or fabric filters, and wet limestone desulphurization. A new district heater component designed to more easily interact with steam turbines over a wide load range is included.

(7) THERMOFLEX now has an automated steam turbine loading mode. It causes steam flow to the turbine to be adjusted so the turbine's shaft output or its generator power balances another load in the plant.

(8) The off-design UA model for THERMOFLEX virtual HRSG heat exchangers was improved to include effects of stream temperatures and pressures. The list-style input menus for these components were replaced by user-friendly graphical menus.

(9) STEAM PRO and STEAM MASTER now include a pulverizer capacity model to estimate coal handling capacity as a function of fuel hardness, desired fineness, and moisture content.

(10) STEAM PRO and STEAM MASTER include THERMOFLEX's improved PEACE models for flue gas desulphurization and flyash removal.

(11) PEACE cost estimates in all programs were updated to reflect an up tick in gas turbine pricing, and to track continued strong demand for labor and basic commodities including steel and concrete.

(12) A new automated hardware key expiration notice and simplified key refreshment process using Thermoflow's web server is in place to simplify license management.

These developments along with a number of other smaller improvements are described in more detail below.

GT PRO / GT MASTER / PEACE

Chapter 15 of the GT PRO manual and Chapter 11 of the GT MASTER manual should be replaced with the new ones included with this update. These chapters were rewritten to reflect the significant changes made to the IGCC model in each program. In this version we introduce hardware-based models for the gasifier vessel, radiant syngas cooler, and convective syngas cooler. These cooler models compute heater geometry, heat transfer areas, and overall weights and dimensions along with the heat balance. This data is used in the cost estimating procedure so changes in heater configuration, materials, or sizing parameters logically flow through to the cost estimate.

Gasification input menus were updated so the built-in gasifier types 1, 2, and 3 are graphically presented consistent with the selected type. Assumptions for thermodynamic inputs, material choices, and sizing criteria are initialized to reasonably reflect current designs. Additional streams from the steam cycle are now available to transport heat from the gasification plant to the power island. The gas cleanup system now includes a CO shift option with supplemental steam taken from the steam cycle if desired. The ASU model for the intercooled compressor trains is more detailed allowing for selection of the number of stages of compression and intercooling.

New graphical outputs were added to better illustrate the calculation result including an overview of the entire IGCC plant, an IGCC heat balance diagram showing overall in- and out-flows, as well as internal transfers amongst the four main plant sub-areas; power island, gasifier, gas cleanup, and ASU.

New output graphics to visually present heat balance results using block diagrams and pie charts were added to both GT PRO and GT MASTER. These programs now provide up to 45 separate graphic outputs and about 30 different text reports to completely describe a run. Therefore, a new two-tiered tab system was introduced to make it easier to navigate to the desired schematic or text report. Outputs are now organized into nine topical sections; System, Gas Turbine, HRSG, Steam Turbine, Cooling System, Gasification, Desalination, Energy Charts, and Miscellaneous. The text reports now retain formatting when pasted into MS Word and MS Excel.

A number of other modifications were made, some of which are listed below:

1. Prices for small steam turbines, approximately 30 MW and below, were revised upwards. Note that significant performance and cost variations exist amongst the large number of vendors of small steam turbines. Default steam turbine designs from Thermoflow programs are biased towards the higher efficiency end of the spectrum. As always, you can enter steam turbine efficiency data you receive from a vendor to ensure heat balances reflect OEM expectations.
2. The automatic procedure for HRSG fin material selection was revised. TP304HG and Super304H materials were added to the HRSG heat exchanger materials list for high pressure and high temperature applications.
3. The gas turbine now allows injection of externally supplied gas into the combustor.
4. The IGCC model now allows you to decouple syngas production from power plant fuel usage by specifying clean or raw syngas flow directly.
5. Desalination heating steam can be LPT exhaust from a condensing turbine that “exhausts to process”.
6. The Economics menu was revised and now includes independent inputs for gas turbine fuel price, duct burner fuel price, syngas export price, plant water import price, and CO2 emission penalty and annual allowance.
7. PEACE cost estimates were updated to reflect an up tick in gas turbine pricing, and to track continued strong demand worldwide for labor and basic commodities including steel and concrete.

Gas Turbine Data Base Update

The gas turbine data base, used by the various Thermoflow products has been updated, as follows:

Newly-included models			
304	Siemens SGT5-3000E (V94.2A)	318	GE LM2500+RC (G4) (60 Hz)
305	Siemens SGT6-6000G (W 501G)	319	GE LM2500+RD (G4) (60 Hz, DLE)
317	Siemens SGT6-3000E (W 501D5A)	320	GE LM2500+RC (G4) (50 Hz)
324	Siemens SGT5-4000F (V94.3A)	321	GE LM2500+RD (G4) (50 Hz, DLE)
		322	GE LM2500+RA (G4) (50/60 Hz)
314	Solar Titan 130-20501	323	GE LM2500+RB (G4) (50/60 Hz DLE)
315	Solar Taurus 65-8400	311	GE 9171E
316	Solar Taurus 70-10302 S	312	GE 9171E (DLN)
		313	GE 9351FA

307	Pratt & Whitney FT8 Power Pac		
308	Pratt & Whitney FT8-3 Power Pac	306	Mitsubishi MHI 701F
309	Pratt & Whitney FT8 Twin Pac		
310	Pratt & Whitney FT8-3 Twin Pac		
Modified models			
255	GE 6581B		

Estimated prices for all engines were updated. Prices were revised upwards for most, but not all engines, with an average increase of about 10% over the entire library.

THERMOFLEX / PEACE

Chapters 7 and 13 of the THERMOFLEX manual should be replaced with the new ones included with this update, as significant portions of these have been rewritten to reflect improvements in Version 16.

THERMOFLEX now includes the material database from REFPROP 7.0, a software program developed at the U.S. National Institute of Standards and Technology. We licensed the software for inclusion in THERMOFLEX without any need for you to acquire a separate license from NIST. In this version, 39 additional materials from the REFPROP database are available on THERMOFLEX's refrigerant selection list. Many current refrigerants including R134A are included along with a number of hydrocarbons, CO₂, and some other common substances. A complete list can be viewed from within the input menu of any refrigerant source (purple source icon). The REFPROP database typically covers the subcooled, saturated, superheated and supercritical regions making evaluation of a wide range of cycles possible for any of these pure fluids.

THERMOFLEX includes three new PEACE components for flue gas handling commonly used in conventional coal fired power plants. They are located on the newly added 'Flue Gas' tab on the component bar. A complete system model of a wet limestone forced-oxidation FGD component was added. It includes the absorber towers, pumps, byproduct dewatering and flue-gas reheating sub-systems in one icon. Models of a bag house filter and an electrostatic precipitator were added to trap flyash particles emanating from combustion of solid fuels. Red fluid streams now carry along ash, NO_x, SO₂, and other constituents making it easier to design flue gas treatment systems connected in the flow path.

THERMOFLEX now has an automated steam turbine loading mode. It allows steam flow to the turbine to be adjusted so the turbine's shaft output or its generator power balances another load in the plant. This is helpful for modeling turbine drives for compressors and other equipment when the known quantities dictate the equipment's loading condition. In these cases, the steam demand required to satisfy the load becomes the dependent parameter.

For the virtual HRSG heat exchangers within the Gas/Air component group, the off-design UA model was modified to include corrections for gas temperature and molecular weight, and steam pressure and temperature in an attempt to add more realism to this simplified modeling method. As you can see from PEACE component outputs, these effects can become very important when operating conditions deviate

too far from the design point. The input menus for the virtual economizer, evaporator, superheater, and deaerator were updated to have a user-friendly graphical screen similar to their PEACE counterparts.

The new PEACE district heater component is a feedwater heater that includes several modes for controlling district heating water final temperature. This model is suitable for large and small systems alike. It has control logic to govern final water temperature over a wide range of water flows. It is designed to work with a steam turbine operating in extraction or back pressure mode. Sample files S4-10, S4-11, and S4-12 illustrate how to use this component and are an invaluable resource for anyone wishing to use this feature.

The reciprocating engine data base used by THERMOFLEX and RECIPRO was updated as follows:

Newly-included models			
359	CAT DM3195-00	367	CAT 12CM32
360	CAT DM3194-00	368	CAT 12CM32
361	CAT G16CM34	369	CAT 16CM32
362	CAT G16CM34	370	CAT 16CM32
363	CAT 8CM32	371	CAT 9CM43
364	CAT 8CM32	372	CAT 9CM43
365	CAT 9CM32	373	CAT 12CM43
366	CAT 9CM32	374	CAT 12CM43

A number of other modifications were made, some of which are listed below:

1. Prices for small steam turbines, approximately 30 MW and below, were revised upwards. Note that significant performance and cost variations exist amongst the large number of vendors of small steam turbines. Default steam turbine designs from Thermoflow programs are biased towards the higher efficiency end of the spectrum.
2. Additional red fluid node on gas turbine icon allows injection of gases into the combustor to model IGCC and other situations where high pressure gases are injected for power augmentation or NOx control.
3. PEACE pump automatically recirculates flow to its inlet to prevent operation below minimum sustainable flow.
4. Radiant boiler energy input can include a user-specified fraction of fuel handling power to allow inclusion of pulverizer power in the boiler heat balance. The Radiant boiler now uses a gas-side fouling factor to model slag-induced resistance to heat transfer at the water wall. The superheater and reheater circuits can now be used to heat liquid water in addition to their normal steam heating duties.
5. PEACE water cooled condenser allows the network to dictate cooling water flow to facilitate modeling situations where the CW flow is known *a priori* or externally controlled, as in certain district heating systems and cases with condensers in series.

6. THERMOFLEX no longer requires use of the period as the decimal separator – Regional settings can be set as you please.

STEAM PRO / STEAM MASTER / PEACE

Chapter 14 of the STEAM PRO manual should be replaced with the new one included with this update, as the flue gas treatment system improvements for Version 16 are documented there. STEAM PRO includes a pulverizer design procedure to compute nameplate coal handling capacity for each unit. At off-design, STEAM MASTER estimates current pulverizer coal handling capacity as a function of current fuel hardness, desired fineness, and moisture content. This is expected to be helpful when analyzing the impact of changing or blending fuels in operating plants.

STEAM PRO and STEAM MASTER now use the improved THERMOFLEX PEACE components for the FGD, bag house filter and ESP system. This brings entirely revised design, simulation, and cost models to this new version. These components are described in the THERMOFLEX section above.

New heat balance pie charts and block diagrams are included to better illustrate computed energy flows and breakdowns in both STEAM PRO and STEAM MASTER.

The Plant Summary, Steam Cycle, Feedwater Heating, and Boiler Summary text output reports have been updated to improve readability and to facilitate copying text reports to other applications, particularly MS Excel. The steam cycle stream table has been expanded to include all states, some with new stream numbers, and to display entropy as well.

The CFB now includes a convective evaporator (CEV) which is particularly useful in smaller plants. The ability to design plants with multiple CFBs per steam turbine is also now available. This facilitates using reference CFB designs in power stations of various sizes.

A number of other modifications were made, some of which are listed below:

1. Prices for small steam turbines, approximately 30 MW and below, were revised upwards. Note that significant performance and cost variations exist amongst the large number of vendors of small steam turbines. Default steam turbine designs from Thermoflow programs are biased towards the higher efficiency end of the spectrum.
2. Cooling towers can use sea water as the coolant.
3. The ASME format for boiler heat balance has been added as a text output available under Tables tab -> Boiler -> Heat Balance -> ASME Energy Balance.
4. PEACE cost estimates were updated to reflect continued strong demand worldwide for labor and basic commodities including steel and concrete.

GENERAL

The web-based registration process introduced in TFLOW15 made software installation far easier for most customers. Starting with this version, all hardware keys will be refreshed using a similar process, requiring connection to Thermoflow's web server. This process will greatly simplify the key refreshment process and will ensure you are notified of license expiration in a timely fashion.

As with software registration, you can connect to the web server from the computer running Thermoflow software, or from any other online computer. Once the license fee is received by Thermoflow, registered users will receive an email indicating refreshment codes are available so you can refresh your key. Instructions provided in that email will tell you to select the Refresh Hardware Key menu item available under the Help menu in all programs. Alternatively, when your key has expired, or is within thirty days of expiration, you will receive an expiration notice when you start a program. That notice will allow you to connect to the web server to refresh the key if the invoice has already been paid.