February 29, 2012

Dear Customer,

We are pleased to enclose a major upgrade to our software suite, Version 22, with the following highlights:

(1) Reduced computation time (increased computation speed) for all programs.

(2) Simplified annual model for estimating project cashflow in GT MASTER and STEAM MASTER.

(3) GT MASTER includes new chiller operating modes for plants including chilled water storage. It also has a feature where one file can model plant operation over a 24-hour period when the chiller system includes storage.

(4) STEAM PRO has a Black Box Steam Generator model and a Bubbling Fluid Bed Boiler model.

(5) STEAM PRO includes a design Methodology selection that affects how the heat balance and hardware design are inter-related.

(6) THERMOFLEX includes a Searcher feature that automatically finds the value of a model input parameter that yields a maximum or minimum value of a model output value.

(7) Solar Tower model with and without storage was added to THERMOFLEX.

(8) THERMOFLEX has a Black Box Steam Generator component for simple boiler modeling.

These developments along with other smaller improvements are described in below.

COMMON ITEMS

The computation engines for all programs were modified and recompiled to reduce computation time. The current programs will reduce the computation times by 30% to 50% relative to the previous version.

In GT PRO and STEAM PRO, project cashflow results are based on design performance assumed to apply for a specified number of operating hours per year. Prior to this version, the same method applied in GT MASTER and STEAM MASTER, although at off-design the user could edit the nameplate data. More detailed analysis could be done using E-LINK. Now, in a single GT MASTER and STEAM MASTER file, cashflow can also be computed using a simplified annual model to describe year-long plant operation. Ambient conditions, equipment operating inputs, and commodity prices are specified in six bins representing peak and off-peak operation in summer, winter, and spring/fall (shoulder) periods. The number of hot and cold starts is included to estimate the impact of added fuel consumption from plant startup. The program computes all the heat balances and integrates the technical and economic results into a single cashflow output displayed in PEACE.

Gas turbine prices were adjusted based on Gas Turbine World Performance Handbook 2012, except that aero engine prices were set somewhat higher to reflect current market trends for that class of machine. Overall PEACE cost estimates, which had been revised upwards in TFLOW21, were not otherwise adjusted for TFLOW22.

Air Cooled Condenser now includes an option to select variable speed fans in design mode. This affects condenser cost and the logic for optimized ACC loading in off-design. In GT MASTER and STEAM MASTER, optimizing logic can adjust the speed of all running fans in unison to maximize net power.

An off-design option to model hot air recirculation, from discharge to intake, for air-cooled condensers and cooling towers is available.

GT PRO / GT MASTER / PEACE

GT inlet chilling system now has features specifically for systems with chilled water storage. Various operating modes are available that run the chilling system in any of the configurations considering ability to charge or discharge the storage tank. In addition, GT MASTER includes an option for one model file to compute plant operation for a series of twenty-four hours to simulate plant behavior as the daily ambient and operating conditions change while the storage tank is charged and discharged. An option to resize the chiller to match the daily load profile considering tank usage is available.

The selected cycle type for the current GT PRO model can be changed at the **Plant Criteria** topic without losing other cycle-independent inputs. Previously, this could only be achieved by returning to the **New Session** topic. PEACE Plant Criteria data can be imported from another GT PRO model to simplify using common regional cost and site assumptions for multiple designs. These features are intended to assist the user in comparing different plant configurations using common site and cost-related assumptions.

The linkage between GT PRO/MASTER and GE APPS has been restored. This feature allows GT PRO and GT MASTER models to use LM engine performance as directly computed by GE's program. GE APPS licensees should download and install version 3.9.3 (or later) version from the General Electric website using the standard procedure.

GT MASTER's boiler calculations now permit reverse heat transfer - from the steam/water side to the gas side. Previously, if the gas were cooler than the water/steam, the heat transfer was set to zero.

Gas Turbine Data Base

The gas turbine data base, used by various Thermoflow products was updated, as shown below.

Engines added to the database					
425	ALSTOM GT 13E2 [1]	455	Ansaldo AE94.2	428	GE LM1800e Low Power (60 Hz) [1]
462	ALSTOM GT 13E2 – 2005	456	Ansaldo AE94.3A	429	GE LM1800e High Power (60 Hz) [1]
459	ALSTOM GT 24 - 2011	457	Ansaldo AE64.3A	430	GE LM1800e Low Power (50 Hz) [1]
460	ALSTOM GT26 – 2006			431	GE LM1800e High Power (50 Hz) [1]
461	ALSTOM GT26 – 2011	432	Kawasaki GPB 17D [1]	436	GE LMS100PB (60 Hz Wet Cooling)
				437	GE LMS100PB (60 Hz Dry Cooling)
424	Siemens SGT-300 (DLE) [1]	444	Mitsubishi 501J	438	GE LMS100PB (50 Hz Wet Cooling)
447	Siemens SGT-400			439	GE LMS100PB (50 Hz Dry Cooling)
448	Siemens SGT-800-50	458	RR 501-KB7S	440	GE LMS100PA (60 Hz Wet Cooling)
449	Siemens SGT-800-47			441	GE LMS100PA (60 Hz Dry Cooling)
450	Siemens SGT-700-33	454	MAN Turbo GT6	442	GE LMS100PA (50 Hz Wet Cooling)
451	Siemens SGT-750			443	GE LMS100PA (50 Hz Dry Cooling)
452	Siemens SGT-500-A2	426	GE 7FA.05 [1]	445	GE LM2500 PJ (60 Hz)
		427	GE 7FA.04 [1]	446	GE LM2500 PJ (50 Hz)
Existing engines with modified performance					
265	Siemens SGT-300[1]				

1 These engines were included in web revisions since the March 2011 TFLOW21 release.

THERMOFLEX / PEACE

A 'Black Box Steam Generator' model was added under the **Boilers / HRSGs** tab of the icon selector. This "boiler" focuses on the steam/water side and produces saturated or superheated steam. Two independent superheater/reheater circuits are available, and steam and/or water admissions/extractions are available from the main flowpath. The model has a simple way to treat "heat input", without any connections for fuel or air/flue gas streams. This icon is useful for modeling unconventional boilers, and/or cases where the boiler details are modeled "by others" and the user wishes to impose those results directly.

'Solar Tower' and 'Solar Tower w/ Storage' icons are now available under the **General** tab of the icon selector. These models rely on user-defined tower-field characteristics, and include some basic built-in arrangements. The model can represent surround fields (round or rectangular) with external cavity receiver, or directional (wedge) fields with cavity receivers. The Solar Tower can be used with water/steam, heat transfer fluids (salts, etc.), or gas/air streams. The Solar Tower w/ Storage includes a two-tank direct storage system and can be used with heat transfer fluids; mainly intended for use with molten salt.

THERMOFLEX now includes a 'Searcher' feature that automatically finds the value of a model input parameter that yields a maximum or minimum value of a model output value. It is somewhat similar to the Control Loop, except that instead of targeting a particular value for a model parameter, the Searcher looks for a minimum or maximum value over a range instead. As an example, the Searcher can be used to determine the how many air-cooled condenser fans should be to run to maximize net power generation while operating at a particular ambient condition.

A method to define one or more 'Custom Efficiency' definitions was added to supplement the model-wise Energy Accounting system that's always been part of THERMOFLEX. This new method is flexible in allowing the user to define the numerator and denominator of an Efficiency, Heat Rate, or COP definition. The energy quantities included and the datum point for energy flows are user-selectable. This makes it easy to define individual unit efficiencies for boilers or sub-plants within a larger system model, or system-wide efficiencies that are meaningful for the particular model at hand.

Logical functions were added to some controller icons so the conditions leading to the control action are set by logic involving computed parameters, rather than by direct user input. For instance, the outflow switch previously had a single input to specify which discharge branch was 'on'. Now, in addition, the used outflow branch can toggle based on a logical test involving another model parameter. So, the switch can be set to flip whenever a computed flowrate in the plant is smaller/larger than a preset value. This could be used to implement a steam turbine bypass system that prevents turbine operation when steam inflow is too low.

Free-form 'Notes' can be entered from the input and output menus for each model component. A text box is shown at the bottom of the component input menu and the user is free to enter descriptive text there to document how the model was created, what items were modified and why, and to enter notes intended for others who'll use the model later on.

THERMOFLEX file size was reduced to about 30% of its Version 21 size. Nineteen additional NIST fluids were added to the database since the last version was released, and these were included in web revisions. Model convergence tests now explicitly include power with user-adjustable tolerances specified in kW and percent. The number of nodes on the User-defined Component was increased to twenty inlets and twenty outlets. Maximum single-file model size was increased.

STEAM PRO / STEAM MASTER / PEACE

A Black Box Steam Generator model is available for selection on the **New Session** topic. This is useful for modeling plants with unconventional steam generators such as solar thermal, or in cases where the user wishes to focus primarily on the steam cycle, without concern for the boiler and its myriad details. PEACE is not available for designs using this feature, but these models can be imported to THERMOFLEX where they can be modified and extended as necessary.

A Bubbling Fluid Bed Boiler model is available for selection on the **New Session** topic. These boilers are sometimes used in smaller plants burning low grade fuels. PEACE is available with BFB, but plant size and type is restricted to smaller designs with no more than one reheat.

STEAM PRO now includes a Methodology selection on the **New Session** topic that governs the default inputs in STEAM PRO and STEAM MASTER affecting hardware design procedures and the relationship between hardware characteristics and the heat balance. This implements a feature that's been part of GT PRO/GT MASTER since Version 18.

OTHER DETAILS

All off-design programs now include a new operating mode for multi-valve turbines using LVP control. The new method controls inlet pressure at 'high' and 'low' flows with sliding pressure in-between. The number of valves used for control in the high-flow and low-flow ranges is user-selectable.

STQUIK, Thermoflow's proprietary steam property formulation, was retired. The 1967 and 1997 ASME steam property formulations remain available for use in all programs. Heat balances that had used STQUIK may change somewhat when recomputed in the current version using one of the alternative formulations. Old files using STQUIK will automatically switch to your 'preferred' property system, which will be IFC-67 if it had been STQUIK. In the early years of desktop computing, the complexity of ASME steam property formulations had a significant negative impact on overall cycle calculation speed, and STQUIK provided a needed improvement. Modern computers are now so fast that the STQUIK improvement is minimal, but the effort to maintain three separate property formulations is significant.

Saved E-LINK workbooks are much smaller when the linked heat balance is not saved using its 'compressed-file' mode. In these cases the E-LINK file will be between five and ten percent the size it was in previous versions.

The steam turbine generator power factor is now an input in off-design. The steam turbine leaving loss data are interpolated using smoother curves which may reduce leaving loss slightly in some cases.