January 5, 2010

Dear Customer,

We are pleased to release a major upgrade to our software suite, Version 20, with the following highlights:

(1) Post-combustion CO2 capture using advanced low temperature chemical absorption system is now available in GT PRO/MASTER, STEAM PRO/MASTER, and THERMOFLEX.

(2) An oxygen enriched air-blown gasifier is included in GT PRO/MASTER and THERMOFLEX.

(3) Dry FGD and Seawater FGD models were added to STEAM PRO/MASTER and THERMOFLEX.

(4) Selective Non-Catalytic Reduction (SNCR) for NOx control is available in STEAM PRO/MASTER and THERMOFLEX.

(5) Solar field with two-tank thermal storage is now available in THERMOFLEX.

(6) PEACE costs, currency conversion factors, and regional cost modifiers were revised. Plant cost estimates will be increased relative to TFLOW19 in most instances.

(7) This version runs on 64-bit Windows 7 and Vista operating systems.

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

GT PRO / GT MASTER / PEACE

An 'Advanced' post-combustion CO2 capture system using a low temperature chemical absorption process is now available as an extension of the amine-based CO2 capture model introduced in TFLOW19. This allows modeling systems that promise improved performance relative to those using conventional amine-based solvents.

A two-stage, dry fed, oxygen-enriched air-blown gasification system (Type 4) is now available. It can be used to model systems such as that available from Mitsubishi Heavy Industries (http://www.mpshq.com/pdf/JapanIGCCDemo.pdf). The model includes a dedicated air compressor and a relatively small ASU to generate oxidant with desired oxygen concentration. Fuel and oxidant are fed to the gasifier's first stage. More fuel is fed to the second stage without any additional oxidant. Steam is generated at one pressure to cool the gasifier itself, and is also generated in the convective syngas cooler at one or two pressure levels. The model includes cost estimation.

Other changes were made to improve IGCC modeling. These include an option to include a syngas letdown turbine at the exit of the GCS to recover power as syngas pressure is reduced between the gasification island and the power island. A syngas compressor is now included on the syngas recirculation loop for Type 2 gasifiers. For IGCC plants, post-combustion CO2 capture is now available as an option in addition to the pre-combustion CO2 capture feature introduced in TFLOW19.

HRSG modeling features, previously only available in GT MASTER, are now also included in GT PRO to improve fidelity in function and results between the two programs. These include the Once Through Boiler (OTB) pressure drop calculation, the hydrostatic correction for drum elevation, and the correction factor for computed water-side pressure drop when using DP from hardware.

HRSG design outputs now include scaled tubing diagrams to present how the heat exchanger surface, duct burner(s), and catalysts are arranged in the boiler. The cross sections show flow paths in/out of the screen, tube/row counts, and tubing details for each heat exchanger. Tables are included to describe physical characteristics and performance details for each heat exchanger, as well as for the boiler as a whole. These information-packed diagrams are intended to be printed on large-format printers.

User-defined GT model now includes an option to specify inlet airflow in addition to engine exhaust flow. This is helpful when modeling engines operating with large blow-off flows, such as some aeroderivatives running at part load.

The comprehensive heat balance diagram, introduced in TFLOW19, now includes ‘layers’ that allow the user to selectively include/exclude data from the diagram. For example, it is now possible to choose whether or not to include ST leakage details, internal ST efficiency data, internal GT cycle outputs, etc. on the diagram. Layers are shown/hidden using the ‘Layers’ pane of the DWF Navigation window, summoned from the DWF viewer menu bar located above the comprehensive heat balance diagram.

Gas Turbine Data Base

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

Engines added to the database			
373	ALSTOM GT13E†	374	GE LM6000 PG SPRINT (50 Hz)
		375	GE LM6000 PG SPRINT (60 Hz)
376	ANSALDO AE 94.3A	381	GE LM6000 PH (60 Hz)
377	ANSALDO AE 94.2	382	GE LM6000 PH (50 Hz)
377	ANSALDO AE 64.3	383	GE LM6000 PH SPRINT (60 Hz)
		384	GE LM6000 PH SPRINT (50 Hz)
379	SIEMENS SGT-700	385	GE LM6000 PF SPRINT 15 (60 Hz)
		386	GE LM6000 PF SPRINT 15 (50 Hz)
380	SOLAR MERCURY 50 (Landfill Gas Fuel)		
Existing engines with modified performance			

362	GE LM6000 PG (60 Hz) †	265	SIEMENS SGT-300
363	GE LM6000 PG (50 Hz) †	298	SIEMENS SGT-400

† These models were released in web revisions to the March 2009 TFLOW19 release.

THERMOFLEX / PEACE

The following new components were introduced in this version.

A two-stage, dry fed, oxygen-enriched air-blown gasification system (Type 4) is now available. The component is located on the **Gasification** tab. It can be used to model systems such as that available from Mitsubishi Heavy Industries (http://www.mpshq.com/pdf/JapanIGCCDemo.pdf). The model includes a dedicated air compressor and a relatively small ASU to generate oxidant with desired oxygen concentration. Fuel and oxidant are fed to the gasifier's first stage. More fuel is fed to the second stage without any additional oxidant. Steam is generated at one pressure to cool the gasifier itself, and is also generated in the convective syngas cooler at one or two pressure levels. The model includes cost estimation.

An 'Advanced' post-combustion CO2 capture system using a low temperature chemical absorption process is now available as an extension of the amine-based CO2 capture model introduced in TFLOW19. It is available on the **Flue Gas** tab. While the component still delivers similar functionality to the power plant process model, the new feature allows modeling systems that promise improved performance relative to those using conventional amine-based solvents.

Solar field with two-tank thermal storage is now included and available on the **General** tab. This model extends the functionality of the solar field model introduced in TFLOW18. The storage system operates in parallel with the solar field. It can absorb heat captured by the field, but unneeded by the network, or it can provide additional heat to the network to supplement a shortfall in field capacity. The storage system model is similar in arrangement to that used in the commercially operating Andasol-1 plant in Spain. The model includes cost estimation.

Dry FGD and Seawater FGD system models for flue gas desulphurization were added to supplement the wet limestone forced oxidation system introduced in TFLOW16. They are available on the **Flue Gas** tab. The Dry FGD system uses a dry scrubbing process that is generally used for smaller (less than 300 MW) low-sulfur coal plants or for plants using a solid fuel other than coal (such as MSW or biomass fuels). The Seawater FGD system circulates seawater, typically discharged from the condenser, in an absorber tower where sulfur dioxide from flue gas is absorbed and subsequently oxidizes to sulfate. The acidified seawater leaving the absorber undergoes a neutralization process in the treatment basin by using the natural alkalinity present in a parallel stream of seawater before being discharged back to the ocean. This system is utilized in some power plants burning relatively low sulphur coals (<1.5%), which are located near an ocean coast. These system models include cost estimation.

A model of the Selective Non-Catalytic Reduction (SNCR) process for NOx control was added to supplement the existing Selective Catalytic Reduction (SCR) model. It is available on the **Flue Gas** tab. SNCR uses aqueous ammonia or a solution of water and urea to reduce NOx in the flue gas path of solid fuel fired boilers. Within the appropriate temperature range, the evaporated solution decomposes into free radicals that participate in a series of reactions that ultimately convert NOx into N2 and H2O. SNCR effectiveness is lower than SCR, but capital costs are also lower.

A Direct Contact Gas-Water Heat Exchanger is now available on the **General** tab. This component transfers heat, along with mass, between counter-flowing gas and water (or brine) streams in direct contact. It can heat or cool the gas stream which may be air/combustion products, or gaseous fuel. It is often physically realized as a vessel where water cascades downwards over a series of trays while gas flows upwards. It is useful for moisturizing syngas prior to use in a gas turbine and cooling and drying flue gas upstream of a CO2 absorber tower.

A Choked Orifice component is now available on the **General** tab. The flow rate through a choked orifice is dependent on the upstream pressure and temperature, and independent of downstream pressure. It is used in situations such as dump steam bypass around steam turbines, refrigeration cycles, etc.

A Controlled Splitter component is available and located on the **Controller** tab. It is used to automatically apportion incoming flow between the two outlet branches to achieve a user-defined control objective. An example use is the gas damper in a pulverized coal reheat boiler. The damper maintains reheat steam delivery temperature by adjusting gas flow between parallel superheater and reheater banks. This component models both the physical damper action, with associated pressure drop, and the control logic used to actuate it.

The following summarizes improvements to existing features, introduced in this version.

THERMOFLEX can now import STEAM PRO files created using the ‘Nuclear Steam Cycle’ method, chosen from STEAM PRO’s Start Design topic.

THERMOFLEX’s messaging system was reorganized and a new message type called ‘Remark’ was introduced. The modifications clarify message presentation and focus attention on those messages most likely to be useful in understanding and analyzing the computed result. As such, a number of messages were rewritten, and some messages were removed. Some ‘Warning’ messages were reclassified as ‘Advisories’. A number of ‘Advisory’ messages were reclassified as ‘Remarks’.

‘Remarks’ communicate internal calculation details, and do not signal errors in the calculation. THERMOFLEX does not announce Remarks; rather they can be summoned by clicking **Display** → **Computation Remarks** from the main menu bar.

A revised color coding system was introduced to clarify which fluid types can be connected to icon nodes. Black nodes can connect to any of the seven fluid types. Grey nodes can connect to more than one, but not all fluid types. While the mouse hovers over an icon in the component bar, a legend icon is displayed showing single or multi-colored nodes to define connectivity options.

New fluids were added to the heat transfer fluid database bringing the built-in fluid count to twenty-nine. The heat transfer fluid now also supports ability to define user-defined fluid properties as a function of temperature.

The refrigerant list was expanded with the addition of forty fluids defined using the NIST (REFPROP) property formulation. THERMOFLEX now includes all eighty-four ‘pure’ fluids supported by the current version of REFPROP.

ST PRO / STEAM MASTER / PEACE

An 'Advanced' post-combustion CO2 capture system using a low temperature chemical absorption process is now available as an extension of the amine-based CO2 capture model introduced in TFLOW19. This allows modeling systems that promise improved performance relative to those using conventional amine-based solvents.

Dry FGD and Seawater FGD system models for flue gas desulphurization were added to supplement the wet limestone forced oxidation system that has been available for some time. The Dry FGD system uses a dry scrubbing process that is generally used for smaller (less than 300 MW) low-sulfur coal plants or for plants using a solid fuel other than coal (such as MSW or biomass fuels). The Seawater FGD system circulates seawater, discharged from the condenser, in an absorber tower where sulfur dioxide from flue gas is absorbed and subsequently oxidizes to sulfate. The acidified seawater leaving the absorber undergoes a neutralization process in the treatment basin by using the natural alkalinity present in a parallel stream of seawater before being discharged back to the ocean. This system is utilized in some power plants burning relatively low sulphur coals (<1.5%), which are located near an ocean coast. These system models include cost estimation.

A model of the Selective Non-Catalytic Reduction (SNCR) process for NOx control was added to supplement the existing Selective Catalytic Reduction (SCR) model. SNCR uses aqueous ammonia or a solution of water and urea to reduce NOx in the flue gas path of solid fuel fired boilers. Within the appropriate temperature range, the evaporated solution decomposes into free radicals that participate in a series of reactions that ultimately convert NOx into N2 and H2O. SNCR effectiveness is lower than SCR, but capital costs are also lower.

New sizing options were added to STEAM PRO so the plant can be sized based on boiler fuel flow which is particularly useful for trash burners and some biomass plants. Plants with back pressure steam turbines can be sized based on desired steam turbine exhaust flow sent to process.

DOCUMENTATION

Keeping with tradition, the context-sensitive online help available from within each program was updated to reflect new features, program improvements, and to make the descriptions clearer and more helpful. The online help is the primary source of documentation, and is always available on computers where the software is installed.

Breaking with tradition, we no longer distribute selected update pages with the installation materials for new versions. We found users at many sites do not have physical access to the printed manual, but instead rely solely on the up-to-date online help. At some sites, the printed update pages are tossed out or tucked away in a drawer, never to be seen again. Therefore, to reduce waste and improve delivery of accurate consistent program help, the electronic help files will be the principal source of program documentation.

GENERAL

A new program, U-LINK, is now available for licensing. U-LINK is a programmable interface to our core modeling software. It provides a platform for users to create their own software applications that utilize our calculation engines. It works in programming environments that support ActiveX controls and/or

ActiveX dynamic link libraries. U-LINK's Application Program Interface (API) is straightforward, simple, and the same for all Thermoflow modeling programs. Contact us for licensing details.

We now use a new software installation program for copying and installing files on your computer. This system is slightly different from the previous one, but the install process is largely unchanged and still self-explanatory. This new installer allows TFLOW20 to be successfully installed on computers running 64-bit versions of Windows 7 and Vista.

We introduced a new system for downloading revisions from our website after the March 15 release of TFLOW19, so this will be new to some users but not all. The Help menu item in each core program now includes a Check for Revision… item that allows you to connect to the website to determine if a revision for your installation is available and if so, to download it to your computer. The revision installer will replace files on your computer that are needed to bring your software up-to-date.

Currency conversion factors and regional cost multipliers were updated based on currency data from the end of 2009. PEACE costs were revised, upwards in most cases, leading to increases in estimated plant costs in all programs. Uncertainty in the global economic picture together with capricious currency management programs will likely cause significant regional variability in project costs throughout 2010.