Thermoflow

Comprehensive Thermal Engineering Software

"Since 1989 I have found Thermoflow programs to continue to get better and better in meeting my needs and exceeding my expectations in a variety of power plant engineering applications. Thermoflow programs have proven to be excellent tools for M&A, greenfield power project development, performance test modeling, plant performance optimization, and plant upgrades and repowering. I would recommend Thermoflow programs to any developer, engineer, or plant operator that needs to get his or her work done more efficiently and with improved results."

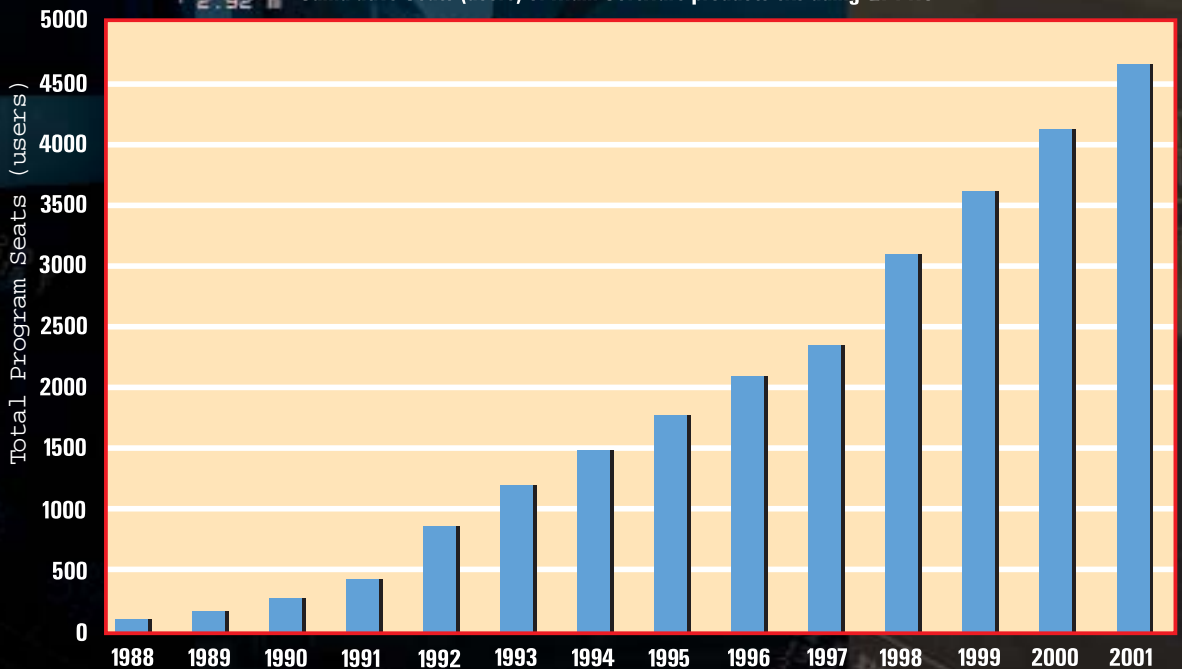Ronald M. Weiner, Director - Engineering, Tractebel Power Inc., Houston, Texas

Maturity & Quality of Thermoflow Programs

■ Over 150,000 man-hours of advanced talent invested, over 14 years of evolution.

■ Written by a group of stable, mature, mechanical engineers, no 'programmers' or external shops ever used.

■ Testing, validation & QC standards greatly exceed those of similiar products on the market.

■ Largest & most mature supplier - over 4,500 programs sold, used an estimated 1 million runs/yr, by 1,500 users at 750 sites.

Thermoflow's success has been derived from a philosophy of technical excellence in all aspects of its products, services and people.

Total Licenses of Thermoflow Plant Modeli

Cumulative Seats (users) of Main Software products excluding QT PRO[2]

Bar chart — Total Program Seats (users) by year:
1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001

Since 1987, Thermoflow has been a leading developer of thermal engineering software for the power and cogeneration industries. Its first product, GT PRO, has grown to become the world's most popular program for designing gas turbine-based plants. By the end of 2001, about 1500 users, at 750 sites in over 50 countries were using GT PRO, making an estimated one million runs per year. Indeed, it may be reasonably assumed that virtually any gas turbine combined-cycle plant built anywhere in the world in the 1990's has been modeled by GT PRO, whether by the owner, developer, financier, consultant, engineer, equipment manufacturer, constructor or operator.

By the end of 2001, Thermoflow had invested over 150,000 man-hours of technical excellence in expanding its line of software products, making it the most mature and comprehensive in the industry.
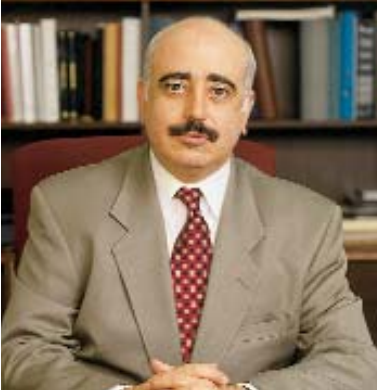
Thermoflow was founded by Dr. Maher Elmasri, who began writing its flagship programs, GT PRO and GT MASTER, in 1987. Dr. Elmasri earned his Ph.D. from MIT in 1978, and until 1987 served as a professor at MIT where he taught graduate and undergraduate courses in Thermodynamics, Heat Transfer and Power and Propulsion. Dr. Elmasri continues to provide technical leadership for Thermoflow's models and programs, even though the primary responsibility for the company's software has now passed into the hands of some of the most outstanding graduates of MIT, all carefully selected and trained by the founder.

A philosophy of excellence

Thermoflow's success has been derived from a philosophy of technical excellence in all aspects of its products, services and people. The excellence of a manufactured product in the power industry is tangible. For example, it can be demonstrated that a turbine has met its claimed power output, heat consumption and reliability. The accuracy of a software model, on the other hand, is much harder to discern. Whereas gross errors are obvious, subtle modeling inaccuracies that produce no violations of heat and mass balances generally go unnoticed. This is especially true in predictive off-design simulation of components and systems, where unsatisfactory modeling techniques can remain undetected by the typical user for years. It is all too easy to concentrate on the visible facade of attractive graphics and sales hype, rather than the unseen core of knowledge that only an expert can perceive. Thermoflow's philosophy, however, has always been to relentlessly pursue engineering excellence and integrity by concentrating on the difficult but critical core of technical details, despite the fact that many users and potential customers never perceive this extra effort.

Thermoflow's philosophy of excellence is firmly rooted in our people. All our engineers who do any programming on our models hold Ph.D. degrees in Mechanical Engineering, many from MIT. The senior staff have all been carefully selected and trained by the founder. Advanced engineering talent is not just used to derive the models and direct program development, but to actually write the programs, and then only after an extensive period of training and observation at Thermoflow. This has minimized errors or oversights, all too common in large engineering models, and ensured that all modeling approximations are fully analyzed and understood before being carefully incorporated into the programs.

Success and stability, based on performance

Thermoflow has never sought nor received funding from sponsoring agencies or outside investors. For fifteen yeras the company has been independent, successful, and profitable because it has provided reliable, high quality software products which truly enhance its customers' productivity. The continuing growth and development of Thermoflow's products is assured by a stable, broad, growing base of satisfied customers, as indicated in the chart on the opposite page.

Repeat business indicates customer satisfaction. Most of Thermoflow's larger customers have ordered more and more copies of its software over the years, and most users of one Thermoflow program have ordered its newer programs. Indeed, many have ordered new Thermoflow products sight unseen, without asking for demos or trials, based on the confidence developed over years of custom.

With Thermoflow, the choice is yours...

THERE ARE TWO TYPES OF HEAT BALANCE PROGRAMS "Application-Specific" and "Fully-Flexible". An Application-Specific program is a special-purpose tool, focusing exclusively on one family of plants. The program includes a vast, general model and the user selects a subset of it via a guided, structured procedure. A Fully-Flexible program is a general-purpose tool, which allows its user to construct any model by connecting appropriate building blocks, in a flexible fashion. Each type of program has advantages and limitations, discussed below.

APPLICATION-SPECIFIC PROGRAMS		FULLY-FLEXIBLE PROGRAM
Advantages	Many system modelling features and details are already in place in a logical, ordered manner. All the user needs to do is select which features to include and the numerical values of its relevant input parameters. Since many complex plant features are already modelled within the software, the user may invoke them by making a few guided selections rather than needing to synthesize their model from elements. Due to the overall logical structure, hundreds of inputs can be automatically created or user-defined, and can be cross-checked and validated to ensure their consistency, preventing errors and crashes.	The program is more general, and can, in principle, model any system that its user wishes to define. The program provides a library of component models, which the user can connect graphically to construct any configuration. This allows greater variety than can possibly be included in an application-specific program.
Disadvantages	The pre-built models are, by their nature, finite. The user is limited to features and details that are within the pre-defined scope of the general model. Thus, in order to have a satisfactory application-specific program, the pre-engineered model must be large and mature enough to ensure that all reasonable features and details are included. Thus, it takes many years to develop a comprehensive family of programs of this type, making them more expensive than a fully flexible program that can cover the same scope.	This type of program normally provides component-logic but leaves system-logic up to its user. The burden placed upon the user is thus, by its nature, far greater than for the application-specific type. The burden placed upon the program itself is also much greater; because it must be capable of gracefully handling system configurations and component applications that its developers have never intended, conceived of, or tested. Since the program cannot always "know" what its user is trying to do, it cannot cross-check all inputs, increasing the possibility of inconsistencies, problematic calculations, and crashes, relative to a robust, well-organized application-specific program.

As the largest and most experienced developer of this type of software, Thermoflow supplies mature comprehensive, stand-alone products of both types. Whether you prefer specialized tools that help you to perfect each job, or whether you prefer to use a single multi-purpose tool for all jobs; Thermoflow has the perfect product for you. Best of all, Thermoflow's programs are mutually compatible, allowing your investment in one program to complement and enhance the value of your investment in the others, if and when you need them.

In **Application-Specific** programs, the plant model is *built from the outside in*. The highest level selections are made first, such as overall configuration. The user then proceeds to lower level decisions, such as selecting the types of subsystems to be included. Finally, the lowest level decisions are made, such as the fine details within the various subsystems. The structured approach automatically considers all interactions between the subsystems. It also allows many lower level inputs to be logically generated by the program, depending upon the user's higher level selections. At any level, however, the user is free to alter any or all of the program's automatic selections. The built-in expertise will satisfy most users, greatly facilitating their task of creating an efficient design in a highly productive fashion.
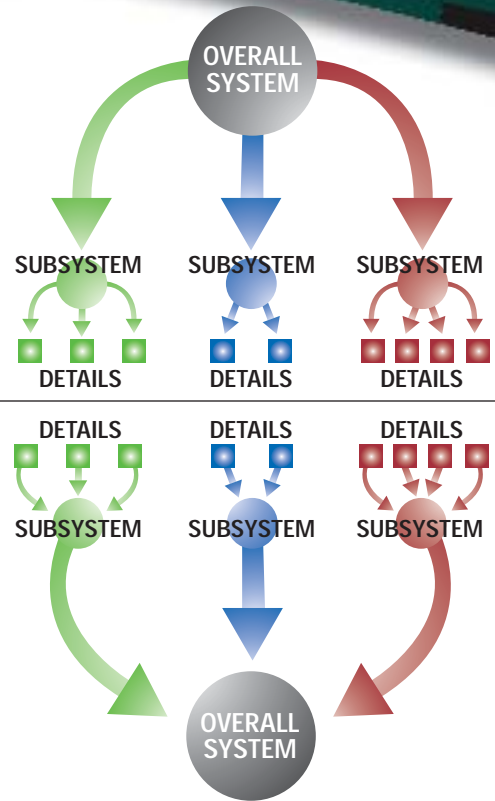
In **Fully-Flexible** programs, the plant model is *built from the inside out*. The user constructs the subsystems from their basic elements, then the overall scheme emerges from the interconnected subsystems. This method allows great latitude, but less structured guidance. Even when one starts from a previously built model, seemingly minor changes in one aspect of the system may require subtle, corresponding alterations in other parameters for an efficient design of the new system. Full flexibility places a much greater burden of labor and logic upon the user.
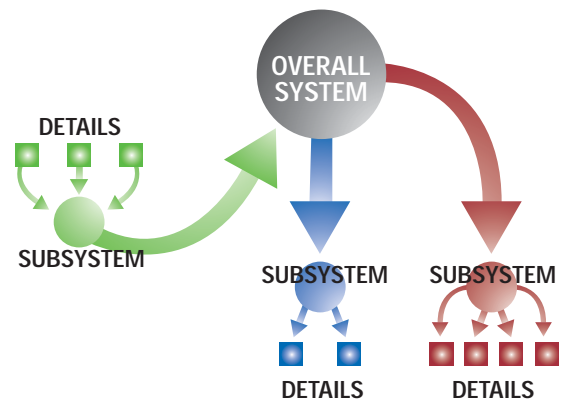
...you can even get the best of both worlds

Thermoflow's application-specific and fully-flexible programs are designed to be used on their own, independently of each other. However, their mutual compatibility and connectivity allows the user who has both types to get the best of both worlds. A plant model may be easily generated in the application-specific environment, and one or more of its subsystems may be custom built in the fully-flexible THERMOFLEX. The hybrid model then operates seamlessly, as a single system.

Furthermore, THERMOFLEX can read a plant model built in the application-specific GT PRO program, allowing the user to transition from fast automated design to a fully-flexible environment.

APPLICATION-SPECIFIC HEAT BALANCE ENGINEERING SOFTWARE

This line includes Thermoflow's most popular programs, **GT PRO & GT MASTER** for gas turbine-based cycles, **STEAM PRO & STEAM MASTER** for pure steam power plants, and **RE-MASTER** for repowering existing steam plants by adding gas turbines. It also includes the **Plant Design Expert (PDE)** program for executive-level use of GT PRO.

GT PRO and STEAM PRO are design programs, which create cycle heat balance as well as the physical design of equipment needed to implement it. GT MASTER and STEAM MASTER are simulation programs that predict performance of the plant as a function of its fixed equipment, control set-points, loads, and ambient conditions. RE-MASTER designs the new equipment needed to convert a given pure steam power plant to combined cycle, then proceeds to simulate performance of the repowered plant at off-design.

Thermoflow's application-specific programs provide an astonishing wealth of modeling detail, yet are deceptively simple to use. Many new users, without training or time spent reading instructions manuals, can produce professional plant designs within a few hours of installing a program. Experienced users normally design a new plant in a few minutes. This seemingly contradictory combination of incredible power and detail with fast, friendly ease of use is the result of thoughtful software design and tireless improvements - the fruit of over

100,000 man-hours invested in the application-specific programs. All input variables have reasonable defaults, or may be generated by automatic procedures within the program to suit the user's application. Non-critical inputs are tucked away into secondary tabs, readily accessible to those who want them, but virtually unnoticed by the casual user. Experienced users who choose to delve into details never cease to be amazed by their depth.

Highly flexible tools, dedicated to each application

Thermoflow's application-specific programs are not "of fixed configuration," a misleading label promulgated by competitors. GT PRO & GT MASTER are highly flexible and can produce endless permutations and combinations of arrangements, that cover virtually any practical combined cycle configuration. Likewise, STEAM PRO and STEAM MASTER cover most practical conventional steam plant designs, and RE-MASTER covers any viable repowering arrangement. However, by their design, GT PRO and GT MASTER cannot model a conventional steam power plant, and STEAM PRO & STEAM MASTER cannot model a combined cycle.

Each of Thermoflow's four main Application-Specific programs has about 2000 inputs, providing extensive flexibility and covering myriad details. This does not make them hard to use, since the structure and automated logic

guides the user through the process in an orderly and organized fashion. A typical GT PRO run may involve changing only 30 of the inputs from their defaults or their automatically-generated values. Thus the flexibility and detail are there when needed, but do not intrude upon the user who just wants a quick heat balance design. A typical plant design can thus be created in under half an hour, but may take days with some fully flexible programs.

Engineering details, automatically and conveniently generated for each heat balance design

Users of Thermoflow's application-specific programs who have licensed the PEACE (Plant Engineering And Construction Estimator) module get instant equipment designs and cost and labor estimates along with each heat balance they produce. The assumptions used to create the physical design and dimensions of components, such as boilers and condensers, may be defined by the user, or left to the program's own automated logic. This provides the flexibility for knowledgeable users to mimic actual designs created by specific vendors, while providing the convenience of automated equipment design logic for the casual user. PEACE also includes detailed pipe sizing procedures for all main steam and water pipes, as well as convenient pump sizing and specification routines.
The cost estimates generated by PEACE are "bottom-up," adding the costs of
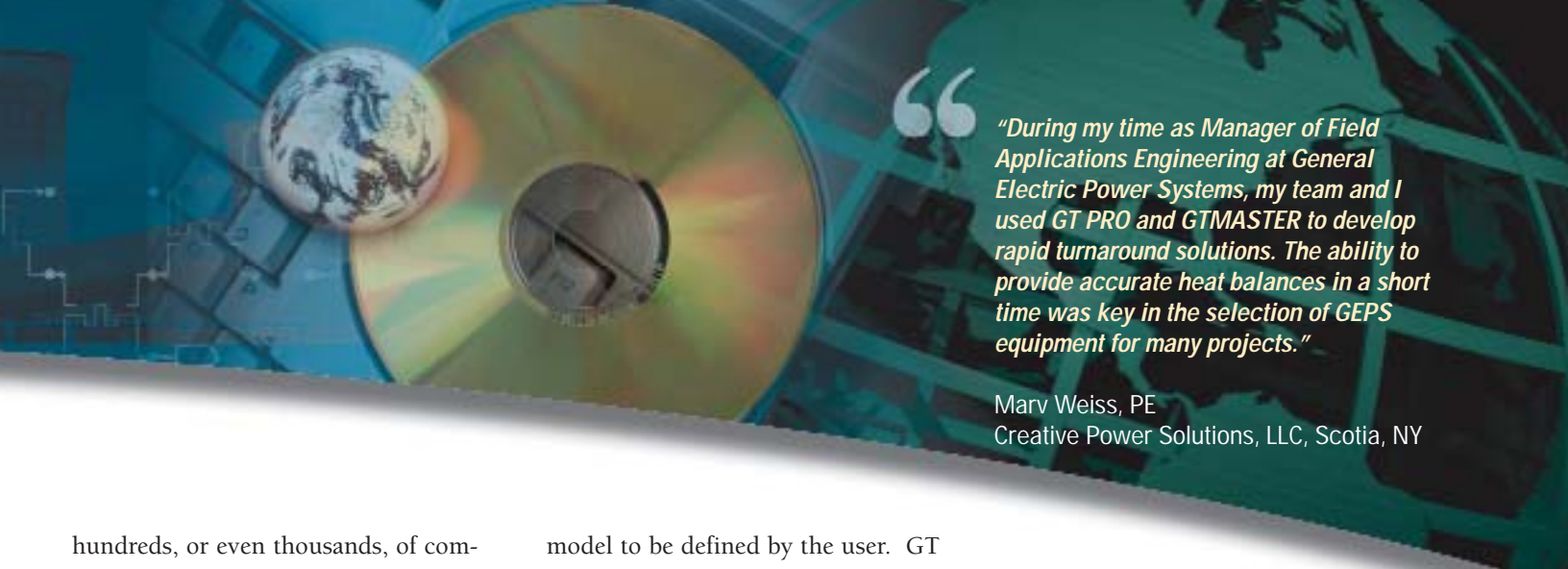
hundreds, or even thousands, of components. The cost and field-labor hours of each component are derived from rational models that take into account the component's features, materials, rating, size and weight. These models have been extensively calibrated by actual equipment data. This approach is in contrast to "top-down" cost estimating procedures, which start with the cost of the system and break-it down according to rules of thumb. Whereas both methods may yield the same final result for "typical" plants, the "top-down" method, by its nature, cannot be sensitive to detail design changes, so cannot be used for optimizing the tradeoffs between cost and performance. The "bottom-up" method used in PEACE can account for changes in design details, even of the secondary components, such as pipes. By finding both the cost and performance impact of each design change, the user may quickly optimize design details, such as pipe sizes, pump selections or HRSG specifications.

Why separate programs for combined cycles and conventional steam plants?

We are sometimes asked why we have separate programs for combined cycles and for conventional steam plants. After all, both types of plant can be modelled by a single fully-flexible program, such as THERMOFLEX. The answer is that application-specific programs provide both plant models as well as component models; whereas a fully-flexible program provides component models only, leaving the plant

model to be defined by the user. GT PRO and STEAM PRO incorporate a logical design philosophy, respectively, for combined cycles, and for conventional steam cycle plants. GT MASTER and STEAM MASTER incorporate detailed equipment modelling calculations and control logic for each of these plant types.

When you are designing a plant (the design phase in our "PRO" programs) there are certain inputs that a reasonable person can assume, which differ between a combined cycle and a conventional steam plant. By knowing what type of plant you are designing, we can help you to create an efficient plant design, by applying well proven logic to automatically derive secondary inputs to suit your primary inputs and selections. We can help you by cross-checking and validating your inputs. Thus GT PRO and STEAM PRO are designed to supply a logical framework that guides the user, in an organized way, through the plant design process. An equivalent methodology is very difficult to provide in a fully-flexible program, which can be used to design both combined cycles and conventional steam plants. The fully-flexible programs, by their nature, end up leaving the user to his or her own devices.

Why different programs for design and for off-design?

When simulating a fixed plant, the types of inputs to describe its operation are its physical hardware and its control actions triggered by various parameters

reaching their set-points. Those types of inputs and the philosophy of organizing and checking them are very different from the inputs used for creating a design. This is why our GT MASTER and STEAM MASTER simulation programs are separate from our GT PRO and STEAM PRO design programs. A fully-flexible program that handles both design and off-design has a more complex structure and a larger set of inputs.

To appreciate the need to differentiate between design and off-design and between a combined cycle and a steam plant, it may be useful to note that each of GT PRO, GT MASTER, STEAM PRO and STEAM MASTER have about 2000 user-adjustable inputs. Had one Application-Specific program covered both plant types and both design and off-design, at an equal level of detail and flexibility, it would have had about 8000 inputs, posing numerous challenges, both for its developer and for its users!

Find out more ...

Install the Thermoflow CD, then click on GT PRO or STEAM PRO. The demo versions contain a few imput restrictions, but allow you to change hundreds of input variables and compute, to observe the effect of your inputs on the results. The PowerPoint tutorials on the CD can help you to become familiar with the programs.

GAS TURBINE COMBINED CYCLES AND COGENERATION

GT PRO: Automates the process of designing a combined cycle or gas turbine cogeneration plant, it is particularly effective for cre... and design parameters. The user inputs design criteria and assumptions and the program computes heat and mass balance, system... of detail in GT PRO has been continuously growing since 1988, to the point that the 2002 version has over 2000 user-adjustable inputs... design procedures that help the user identify the best design with minimal time and effort, while allowing the flexibility to make any c... cally requiring only a few minutes to create a new plant design. It normally computes a heat balance and simultaneously designs the... conjunction with the optional PEACE module, the programs provide extensive engineering and cost estimation details.

GT MASTER: Simulates performance of a given plant at different operating conditions, such as different ambients and loads. The... main control set-points can all be initialized for a plant by simply reading its GT PRO design file. Once a GT MASTER plant model has... facilitates use of correction curves generated by GT MASTER, and helps planners to forecast their fuel consumption and electricity p... engineering and cost estimation functions obtained in conjunction with the PEACE module facilitate optimization of design details, su...

PDE (Plant Design Expert): An "Executive Level" version of GT PRO to help generate a plant conceptual design and heat rate... ates a GT PRO input file based on the user's requirements for the proposed plant. It then runs GT PRO in the background and display... PRO's flexibility and replaces it by a high degree of automated, expert logic, deciding what type of cycle should be used, its configura... eters. PDE provides its user with approximately fifty adjustable inputs to state his/her requirements. The rest of GT PRO's 1500 input...

CONVENTIONAL STEAM POWER PLANTS

STEAM PRO: Automates the process of designing a conventional utility steam power plant.

STEAM MASTER: Simulates performance of a conventional utility steam power plant at different operating conditions.

STEAM PRO and STEAM MASTER are philosophically and functionally equivalent to GT PRO and GT MASTER, but for conventional u... combined cycles.

RE-MASTER: Designs and simulates repowering of conventional steam plants with gas turbines. The program starts with a STEA... rapid, accurate evaluation of the various repowering options. RE-MASTER does both the design and off-design analysis. Its design p... certain items of equipment already exist, with known characteristics, and other new items have to be designed to supplement them. ... details of all viable modes of repowering, including "hot windbox", "boiler replacement", "feedwater heating", and "parallel repower...

PRELIMINARY ENGINEERING & COST ESTIMATION

PEACE (Plant Engineering And Construction Estimator) is a module that is licensed separately, but works seamless... As of January 2002, its functionality within THERMOFLEX was limited to about twenty components, covering heat recovery boilers, c... and expected to be complete in 2002.

When used from within GT PRO or GT MASTER, PEACE provides additional inputs to automate the preliminary engineering and cost... of-plant are derived from the detailed hardware specifications, so that any design change is immediately reflected in corresponding... condensers, or cooling towers; as well as plant subsystems, such as piping, pumps, and gas turbine inlet chillers.

FULLY-FLEXIBLE PROGRAM

eating new designs and finding their optimal configuration
performance, and component sizing. The scope and level
. Most key inputs are automatically created by intelligent
changes or adjustments. GT PRO is truly easy to use, typi-
e required equipment in under three seconds. When run in

roughly 1700 inputs which define plant hardware and
s been fine-tuned, it can be run from within MS Excel. This
roduction and to model their cash-flows. The extensive
ch as pipe sizing or pump selection.

estimate "on the fly". PDE is an intelligent shell that cre-
s abbreviated output results. PDE takes away much of GT
ation details and the numerical values of its design param-
s are generated automatically.

tility steam power plant cycles, rather than gas turbine

M MASTER model of the existing power plant and allows
phase accurately reflects the reality of repowering, where
RE-MASTER handles all thermodynamic and heat transfer
ring".

THERMOFLEX: A modular program with a graphical interface
that allows one to assemble a model from icons representing over
one hundred different components. The program covers both
design and off-design simulation, and models all types of power
plants, including combined cycles, conventional steam cycles, and
repowering. It can also model general thermal power systems and
networks. It answers the need of some customers for a single,
"jack-of-all-trades" program, that is much less expensive than our
complete suite of Application-Specific programs.

THERMOFLEX was first released in 1995 and has undergone relent-
less improvement ever since. A 1999 independent study ranked
THERMOFLEX ahead of all other fully-flexible programs in the mar-
ket, including several that are widely-used and considered fully
mature. As of 2002, over 300 copies of THERMOFLEX had been
licensed, many to GT PRO/GT MASTER customers for use where
full flexibility is needed; such as for modelling gasification plants or
complex district heating arrangements.

Starting with Version 5.0 (August, 2001), many THERMOFLEX com-
ponents have been provided with the detailed physical design and
simulation models used for many years in GT PRO and GT MASTER,
as well as with the engineering and cost estimation functionality of
PEACE.

In addition to being a comprehensive, stand-alone tool, THER-
MOFLEX may be used in conjunction with Thermoflow's application-
specific programs to provide powerful synergies.

ly within Thermoflow's main heat balance programs. Its functionality within GT PRO & GT MASTER is comprehensive, proven and mature.
ooling systems, piping, pumps, and and balance-of-plant items. Its functionality within STEAM PRO & STEAM MASTER is in development,

estimation of each plant, as designed in GT PRO, or as modified in GT MASTER. The logical cost functions for all equipment and balance-
changes in both performance and cost. This greatly facilitates the techno-economic optimization of major equipment, such as boilers,

THERMOFLEX is a fully flexible program that allows you to model a broad range of thermal systems, with emphasis on power generation and cogeneration. It can be used to model gas turbine combined cycles, steam power plants, or repowering, in addition to a virtually endless variety of power plant systems, standard or novel. It provides design and off-design modes into a single program, so you can use one program for all your calclations. In combination with PEACE, it also provides equipment sizing, conceptual engineering details, and cost estimation. THERMOFLEX is an economical alternative for users who have a wide range of application interests, but insufficient activity in any one plant type to justify the cost of the application-specific programs.

To build a model in THERMOFLEX, you simply click on icons representing the components you wish to use, place them wherever you want on your screen, and connect them to other components in your system. User friendly warnings will inform you of inappropriate or unresolved connections. Once your system layout is complete, you can progress through simple, intuitive menus to specify performance parameters for each component.

User-friendly

Thermoflow's experience, developed over fifteen years of serving hundreds of software users, has been harnessed to make THERMOFLEX as user-friendly as

Dr. Elmasri discussing development of the software suite with Vice Presidents Dr. Gwo-Tung Chen (right) and Dr. Patrick Griffin. Chen joined Thermoflow in 1991 after earning his Ph.D. from MIT, and is primarily in charge of GT PRO. Griffin, who joined Thermoflow in 1992, is Elmasri's "grandstudent"; the professor supervising his thesis at MIT was Professor Elmasri's doctoral student.

a fully-flexible program can be. Unlike many other fully-flexible programs, THERMOFLEX will, in the vast majority of cases, solve your initial mass balance for a totally new model without asking you to pre-define an initial mass balance or declare flow rates or components which dictate them. In addition, THERMOFLEX will check to detect inconsistencies in your inputs before launching the computation, and has an extensive system to trap and identify errors or incompatibilities detected during computation. A vast library, with hundreds of diagnostic messages, will guide you to productively resolve any difficulties.

Modular structure

THERMOFLEX is completely modular, with each component represented by an

icon and modeled by its own self-contained subroutine. This approach allows us to continuously expand and improve the program by adding new components or expanding the scope of existing component models while maintaining compatibility with previous versions.

Extensive component library

The THERMOFLEX library contains models for over 100 components. These have a venerable pedigree, since most component models originate from Thermoflow's proven, world-class, application-specific programs. For example, the full gas turbine library and calculation method used in GT PRO and GT MASTER is included in THERMOFLEX Likewise, the proven, robust procedures used to model components such as boil-

ers, condensers, cooling towers or feedwater heaters are adapted from GT PRO/GT MASTER or STEAM PRO/STEAM MASTER. In addition, THERMOFLEX includes additional components that allow modelling plants beyond the scope of GT PRO/GT MASTER or STEAM PRO/STEAM MASTER, such as desalination plants and gasification systems. THERMOFLEX also includes an extensive library of reciprocating engines, with over 350 engine models, both diesel and gas-fired.

A wealth of engineering details

THERMOFLEX users who have licensed the PEACE (Plant Engineering And Construction Estimator) module get instant equipment designs, specifications and cost estimates for many components, such as piping, pumps, fin-fan coolers, chillers, cooling towers, etc.

Compatibility with Thermoflow's application-specific programs

THERMOFLEX, like any other fully flexible program, requires far more time and expertise to design and simulate realistic cycles than our popular application-specific programs. For instance, a complex combined cycle that you can create with GT PRO in a few minutes could require several hours to build from scratch in THERMOFLEX or other fully flexible environments. Software customers and developers have sought the elusive,

perfect compromise between total flexibility and quick set-up for years. Thermoflow is the first developer of thermal power system software to have resolved this conflict. You can simply use GT PRO to rapidly design a large complex combined cycle, then, through a Thermoflow software bridge, transfer the design into THERMOFLEX, where you can make modifications or additions or even combine it with other THERMOFLEX files. You can even link THERMOFLEX models to one or more GT PRO/GT MASTER models. For instance you can build a combined cycle in GT PRO/GT MASTER and link it to a THERMOFLEX network. Steam, water, air, flue gases, or fuel entering (or leaving) the GT PRO/GT MASTER models can come from (or go to) the THERMOFLEX network. Automatic matching of flow rates and pressures at

the boundaries between such hybrid models ensures that the entire hybrid model functions as a single, integrated system. This procedure greatly facilitates modelling complex systems, such as IGCC (Integrated Gasification Combined Cycles), District Heating, or Desalination.

Find out more ...

To try THERMOFLEX, install the Thermoflow CD, then click on the THERMOFLEX icon. This will start a limited version of THERMOFLEX, with reduced but highly-useful functionality. Please enjoy it with our compliments! Your CD contains a \Tutorials directory which includes a few THERMOFLEX tutorials in MS Powerpoint to help introduce the software to new users.

The 365-megawatt Selkirk Cogeneration Plant relies on Thermoflow software to monitor plant performance.

QT PRO² (Quick Thermal Properties and Processes)

Thermoflow's QT PRO² program (Quick Thermal Properties and Processes) provides a convenient, user-friendly tool for anyone who frequently performs simple, fundamental calculations involving heat transfer or thermodynamics. With a massive library of substance properties linked to commonly used thermodynamics and heat transfer formulas, it is an invaluable tool for engineers or students in the mechanical, chemical, or process industries. QT PRO² is included in Thermoflow's Engineer's System software bundle.

RECIPRO

An Excel add-in that enables plant engineers and consultants to rapidly evaluate and and optimize cogeneration system selection for hotels, hospitals, institutional buildings and small industrial applications. It is simple and bottom-line oriented, starting from the monthly utility bills. It can generate detailed predictions of energy savings for hundreds of cogeneration system options, using an extensive database of reciprocating engines, ranging from 70 kW to 6 MW. The program considers daily load profile variations for electrical, heating, and air-conditioning loads and can analyze the effect of substituting absorption chillers for electrically driven units to make better use of cogenerated heat. It evaluates different operating scenarios, identifying the savings for each. It also allows different on-peak and off-peak pricing, and different electricity prices for purchase and sale.

GTeye

A gas turbine performance monitoring program for on-line or off-line use. Inexpensive and easy to configure and install, GTeye is satisfies the need for a simple, reliable performance monitor for bottom-line oriented operators.
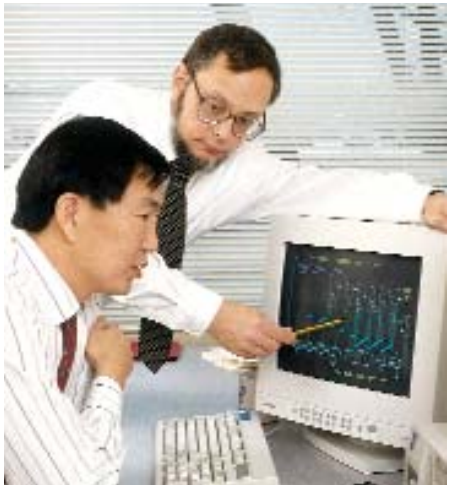

> " *"No button pushing and pre-recorded menus to fight - you get real people with real answers, who remember your company and your needs call to call."*
>
> Glenn A. Sampson, P.E.
> Advanced Energy Solutions, Inc., Middlefield, CT

Dr. Gangyi Jia discussing STEAM PRO and STEAM MASTER with Dr. Norman Decker. Since joining Thermoflow in 1991, Jia has made many contributions to the software product line. Decker is familiar to hundreds of Thermoflow customers who have attended the software training classes he has taught over the years.

Professional Development Seminar

Since 1990, Thermoflow has sponsored a three-day, in-depth, professional development seminar on the design of combined-cycle and cogeneration systems. The course focuses on understanding the application of fundamental principles to practical, efficient design and selection of equipment and cycles. It is mainly taught by Dr. Maher Elmasri, Thermoflow's founder.

Thermoflow's "Design of Gas Turbine Combined Cycle" seminar held in Frankfurt, December 1998, and co-sponsored by Lahmeyer International. Back row, from left is Petra Kupsch of Lahmeyer, followed by Dick Foster-Pegg, who has participated in teaching the seminar for many years, and Maher Elmasri. Since 1990, the seminar has been held about 40 times worldwide and attended by about 1500 engineers.

Software Training

Thermoflow has successfully striven to impart user-friendliness and logical structure to our programs. While most customers use the programs confidently and successfully on their own, there are also customers who seek, and benefit from, training in the use of the programs. Even experienced users have been pleased to discover in training sessions that powerful features and intricate details they had wished for, but not expected, are already at their fingertips.

Training is provided at scheduled sessions, advertised in advance to registered program users, and attended by people from multiple organizations. We also hold training sessions in various parts of the world at our customers' sites, by special arrangement.

Consulting

Thermoflow is pleased to serve its clients in a consulting capacity, drawing on its wealth of software tools and unique, wide-ranging experience with modeling power plant equipment and systems. Whether you need to interpret test results, produce correction curves for plant performance, assess equipment conformance with warranties, commission a repowering study or seek to improve heat rate, Thermoflow is sure to provide you with high-quality, reliable answers at competitive cost.
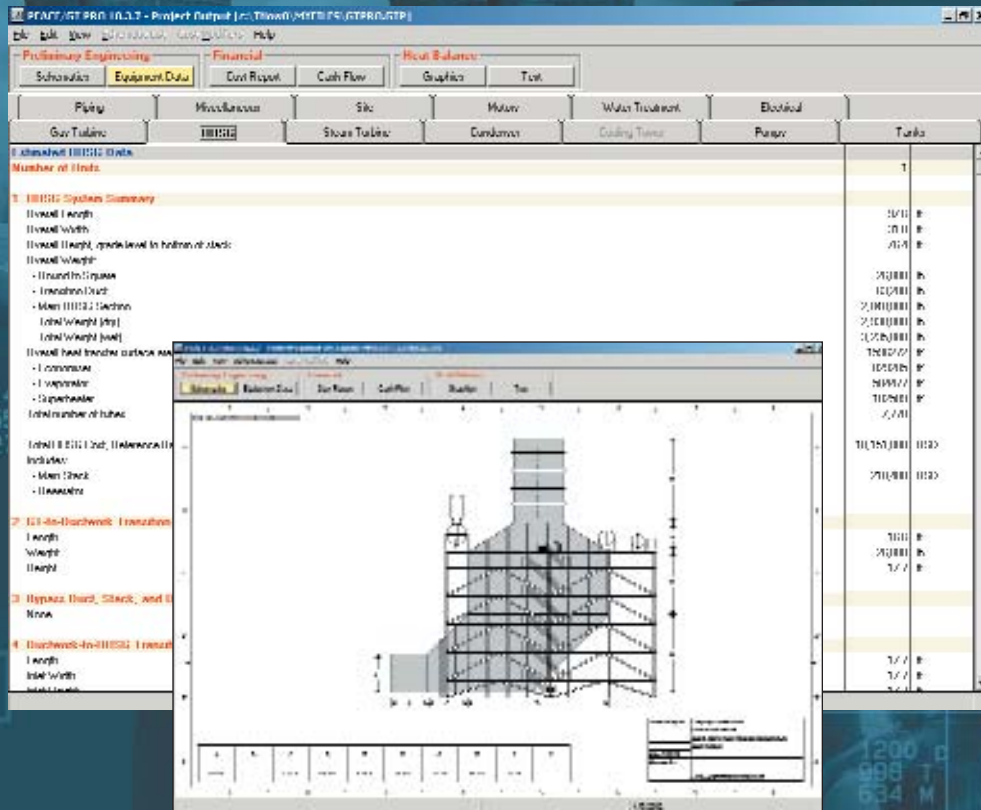
"We use PEACE to determine the capital cost impact of varying design options when configuring a plant, and have generally found the PEACE overall plant equipment and construction costs to be within 10% of the actual costs. We have used GT MASTER and STEAM MASTER to investigate literally dozens and dozens of potential projects. They are excellent tools to determine the best approach to take, and I can, within one day, determine the optimum plant cycle."

Terry Jordan, P.E., Cogentrix Energy, Inc., Charlotte, NC

"We have used GT PRO and GT MASTER since 1988 for feasibility studies, design planning of new power stations or rehabilitation of existing plants. Since that time, the programs became more and more user friendly and a lot of useful engineering tools have been added. During the last years, we have used also STEAM PRO, STEAM MASTER, THERMOFLEX and PEACE. For an engineering company, it is very important to have such programs which provide us efficient and precise outcome and make it possible to consider all kinds of possibilities in a short time. We cannot imagine our work without these programs."

Petra Kupsch, Lahmeyer International, Germany

"As one of the users of GT PRO/GT MASTER from their beginnings, I feel that these programs are really recommendable if you are looking for cycle simulation software of gas turbine-based power plants. ..... At the contract negotiation stage of the project, we found that the owner's consulting engineering company was also using GT PRO and GT MASTER, and they specified that the GT PRO and GT MASTER simulation electronic files shall be submitted as one of the contractual documents."

Ho Y. Choi, Daelim Industrial Co., Ltd., Seoul, Korea

"Thermoflow's software allows us to quickly evaluate a number of potential avenues and our clients are impressed with our rapid response. We could not do it without the products of Thermoflow."

Sean Nolan, ANNA, Inc., Lanham, MD

"GT PRO has proven to be an extraordinarily valuable tool for our company."

Andy Sutherland, Cummins & Barnard, Inc, Ann Arbor, MI