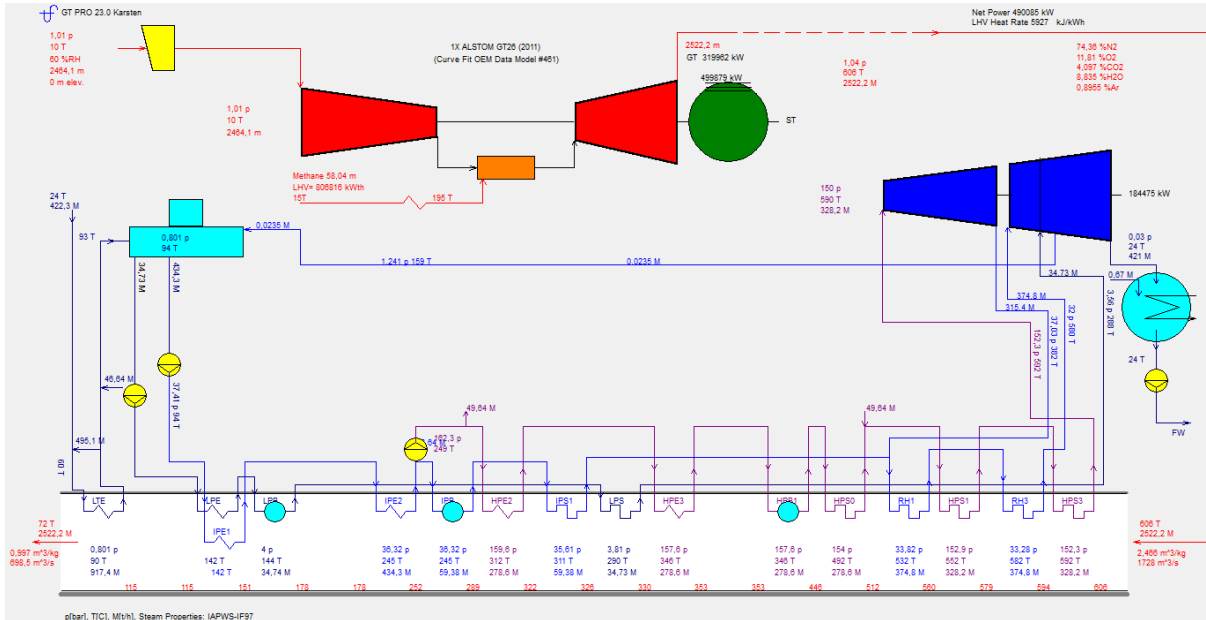
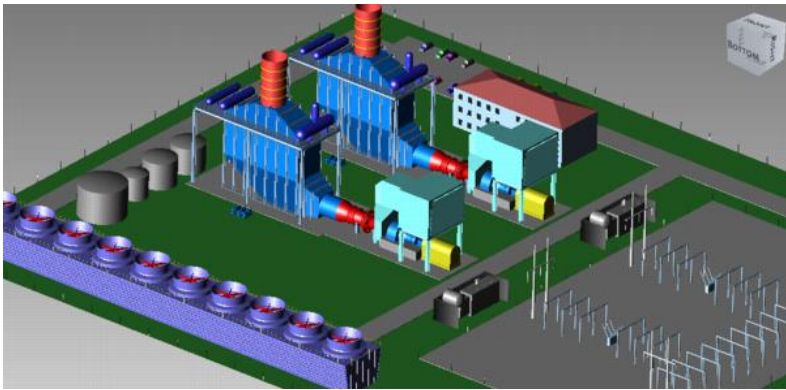


## **GT & Recip. Engine Combined Cycle Design, Simulation, and Cost Estimation**

**GT PRO® is an EXPERT PROGRAM** and automates the process of designing a gas turbine or reciprocating engine based power or cogeneration plant. GT PRO is particularly effective for creating new designs and finding their optimal configuration and design parameters considering technical performance and total plant cost (**techno-economic optimization**).



Cycle Flow Schematic: GTCC, Single-Shaft, 3p-RH



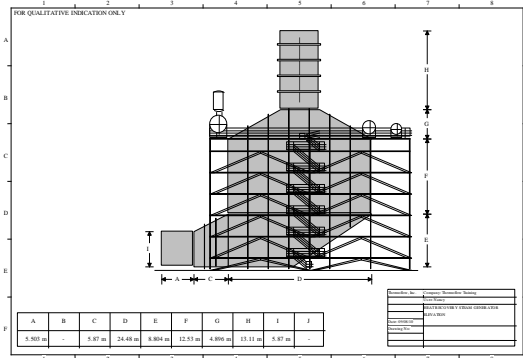
PEACE Output: Site 3D View

Most key inputs are automatically created by intelligent design procedures that help the user identify the best design with minimal time and effort, while allowing the flexibility to make any changes or user-adjustments.

**GT PRO** is truly easy to use, typically requiring only a few minutes to create a new plant design. It computes a heat balance and simultaneously designs the required equipment and site infrastructure.

**GT MASTER®** is the Off-Design Simulation companion to GT PRO. GT MASTER computes (steady-state and **transient**) performance for varying ambient conditions, fuel selection, equipment loading, process steam/water flows, hardware degradation levels, etc. The TIME feature (**Time Integrated Modeling Economics**) computes the project's NPV considering cold/warm starts and shutdowns, various loads and ambient conditions throughout the year.

The user inputs design criteria and assumptions and the program computes heat and mass balance, system performance, and equipment sizing. The scope and level of detail in GT PRO has been continuously growing since 1988, to the point that the latest Version 30 has over 4,000 user-adjustable inputs.



PEACE Output: HRSG Elevation 2D View

Preliminary Engineering			
Schematics		Equipment Data	Financial
Soft & Miscellaneous Costs		Gasification Plant	Desalination Plant
Mechanical		Electrical Assembly & Wiring	Buildings
Specialized Equipment		Other Equipment	CO2 Capture Plant
Engineering & Plant Startup		Civil	
<b>Project Cost Summary</b>		<b>Reference Cost</b>	<b>Estimated Cost</b>
<b>Power Plant</b>			
I	Specialized Equipment	285,374,000	299,643,000 USD
II	Other Equipment	15,026,000	15,772,000 USD
III	Civil	28,620,000	33,102,000 USD
IV	Mechanical	37,273,000	43,811,000 USD
V	Electrical Assembly & Wiring	7,806,000	9,136,000 USD
VI	Buildings & Structures	11,821,000	13,395,000 USD
VII	Engineering & Plant Startup	18,638,000	18,676,000 USD
<b>Gasification Plant</b>		NA	NA
<b>Desalination Plant</b>		NA	NA
<b>CO2 Capture Plant</b>		NA	NA
<b>Subtotal - Contractor's Internal Cost</b>		404,558,000	433,739,000 USD
<b>VIII Contractor's Soft &amp; Miscellaneous Costs</b>		84,511,000	93,694,000 USD
<b>Contractor's Price</b>		489,069,000	527,433,000 USD
<b>IX Owner's Soft &amp; Miscellaneous Costs</b>		44,016,000	47,463,000 USD
<b>Total - Owner's Cost (1 USD per US Dollar)</b>		533,085,000	574,897,000 USD
<b>Nameplate Net Plant Output</b>		804	804 MW
<b>Cost per kW - Contractor's</b>		608.3	656 USD per kW
<b>Cost per kW - Owner's</b>		663.1	715.1 USD per kW
<i>* Cost estimates as of August 2010.</i>			

PEACE Output: HRSG Elevation 2D View

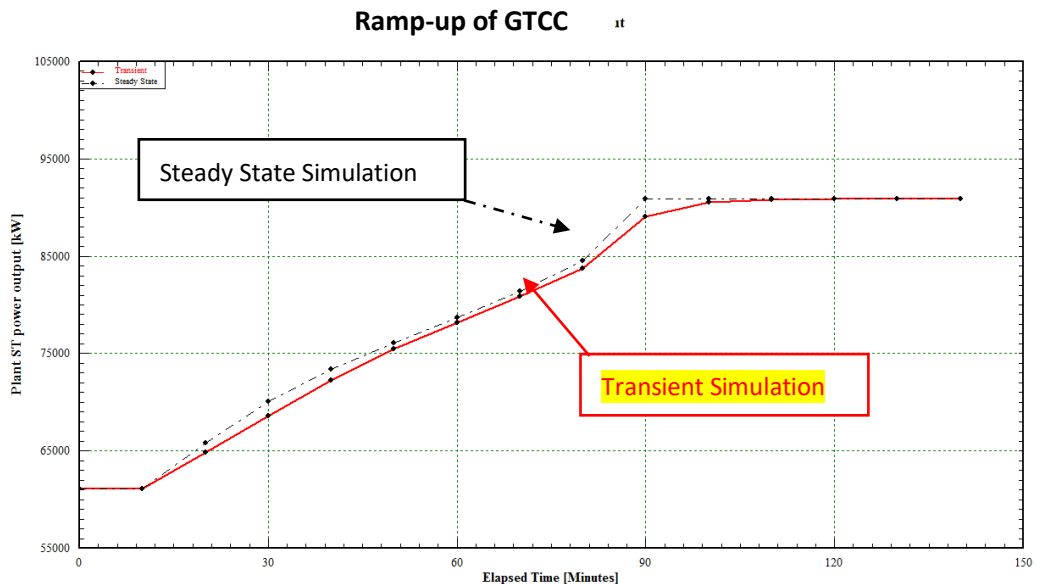
When run in conjunction with the optional **PEACE®** (Plant Engineering And Cost Estimator) module, the programs provide extensive engineering and **hardware specifications** such as weight and dimensions, plant and equipment **cost estimation**, and site details.

**GT PRO** and **GT MASTER** include a built-in library of **over 750 gas turbine and reciprocating engine specifications**, Integrated Gasification Combined Cycles (**IGCC**), Desalination Plants (**RO, MSF, MED**), and chemical / physical **CO2 Capture and Sequestration (CCS)** plants.

A bi-directional Link to MS-EXCEL (**ELINK**) is available, which allows plant models to be run from within MS EXCEL by specifying inputs and receiving outputs in EXCEL cells. ELINK makes it easy to produce Thermal Heat Rate curves, integrated Annual Simulation results, etc.

A built-in scripting language in GT PRO and GT MASTER allows to add own logical blocks to models, or to call an external DLL/EXE, so GT PRO and GT MASTER models can run together with other programs.

**GT MASTER** model(s) can be imported to the new **NOVO PRO** module for **hourly grid simulation** in combination with renewables (Wind, PV) and/or storages and / or Hydrogen Production Plants. This allows the user to create an optimized base load, peaker or backup GT / GTCC plant for an individual electrical grid.



GT MASTER: Transient Simulation of GTCC Ramp-Up and comparison to Steady-State Simulation