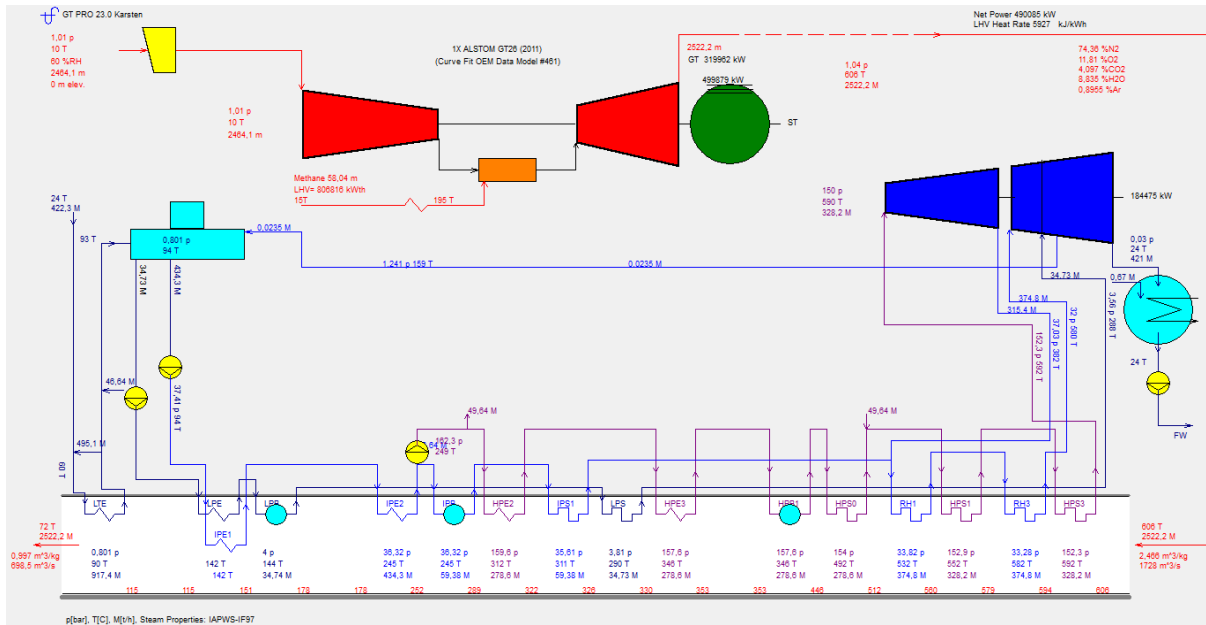
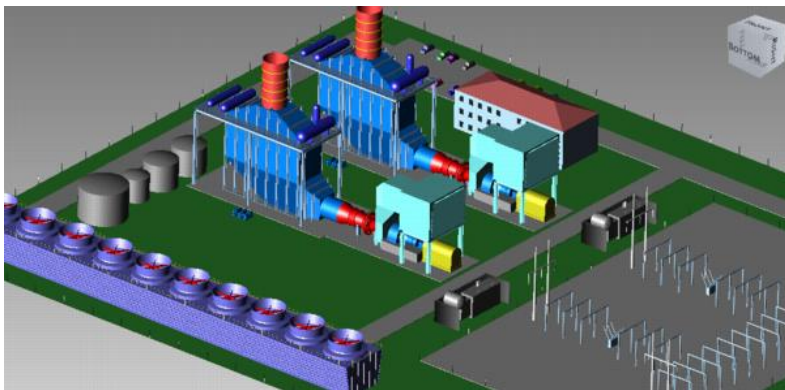


## **GT & Recip. Engine Combined Cycle Design, Simulation, and Cost Estimation**

**GT PRO** 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



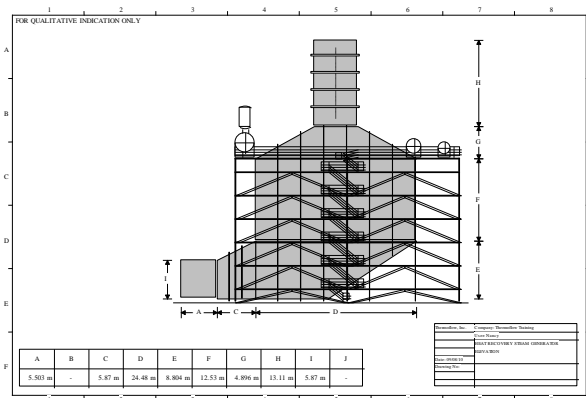
PEACE Output: Site 3D View

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 2016 Version 26 has over 3400 user-adjustable inputs.

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 (**T**ime **I**ntegrated **M**odeling **E**conomics) computes the project's NPV considering cold/warm starts and shutdowns, various loads and ambient conditions throughout the year.



PEACE Output: HRSG Elevation 2D View

| Project Cost Summary                              | Reference Cost     | Estimated Cost          |
|---|--------------------|-------------------------|
| <b>Power Plant</b>                                |                    |                         |
| I Specialized Equipment                           | 285,374,000        | 299,643,000 USD         |
| II Other Equipment                                | 15,826,000         | 15,777,000 USD          |
| III Civil   | 28,620,000         | 33,182,000 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         | 13,595,000 USD          |
| VII Engineering & Plant Startup                   | 18,638,000         | 18,616,000 USD          |
| <b>Gasification Plant</b>                         | NA                 | NA                      |
| <b>Desalination Plant</b>                         | NA                 | NA                      |
| <b>CO2 Capture Plant</b>                          | NA                 | NA                      |
| Subtotal - Contractor's Internal Cost             | 484,558,000        | 433,738,000 USD         |
| VIII Contractor's Soft & Miscellaneous Costs      | 84,511,000         | 93,634,000 USD          |
| <b>Contractor's Price</b>                         | <b>489,069,000</b> | <b>527,433,000 USD</b>  |
| IX Owner's Soft & Miscellaneous Costs             | 44,016,000         | 47,463,000 USD          |
| <b>Total - Owner's Cost (1 USD per US Dollar)</b> | <b>533,085,000</b> | <b>574,892,000 USD</b>  |
| <b>Nameplate Net Plant Output</b>                 | <b>804</b>         | <b>804 MW</b>           |
| <b>Cost per kW - Contractor's</b>                 | <b>608.3</b>       | <b>656 USD per kW</b>   |
| <b>Cost per kW - Owner's</b>                      | <b>663.1</b>       | <b>715.1 USD per kW</b> |

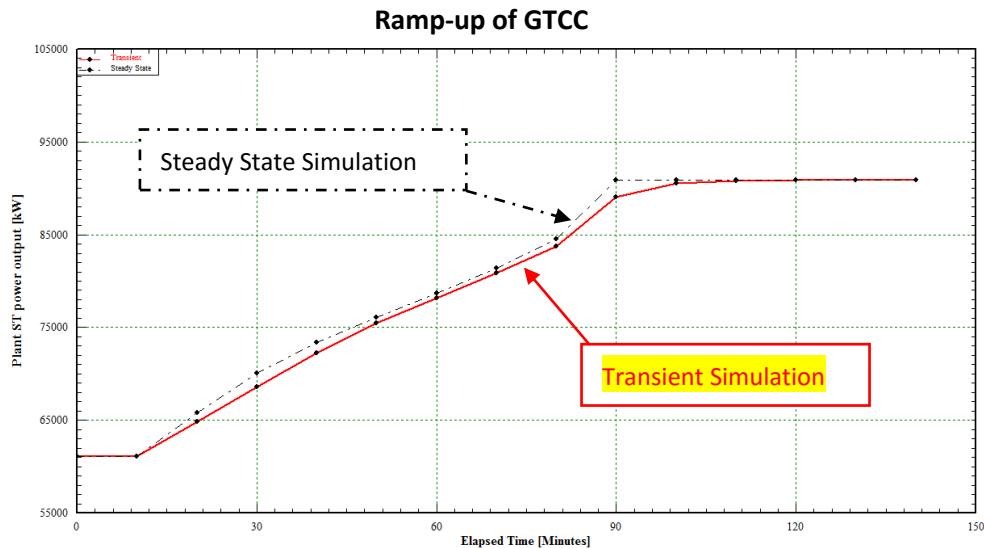
PEACE Output: HRSG Elevation 2D View

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 625 gas turbine and reciprocating engine specifications, Integrated Gasification Combined Cycles (IGCC), Desalination Plants (RO, MSF, MED), and chemical / physical CO<sub>2</sub> Capture and Sequestration (CCS) plants.

A bi-directional Link to MS-EXCEL (**E-LINK**) is available, which allows plant models to be run from within MS EXCEL by specifying inputs and receiving outputs in EXCEL cells. E-LINK 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: Transient Simulation of GTCC Ramp-Up and comparison to Steady-State Simulation