SOAPP-CT Version 8.0 Released

Powerful Tool Integrates Technical and Financial Decision Making

Palo Alto, February 13, 2007: EPRI has announced the release of SOAPP-CT Version 8.0. SOAPP-CT provides integrated technology evaluation/selection, conceptual design, and financial analysis of combustion turbine based power and cogeneration plants. SOAPP-CT automates the plant conceptual design process, generating heat/material balances, equipment selection and sizing, drawings and 3D models, cost estimates, construction schedules, and financial analysis. As the premier power project development software, SOAPP-CT breaks new ground with Version 8.0 by reflecting the current state of deregulating the energy industry.

New Features in Version 8.0 include:

- **Updated Steam Turbine Performance Estimates.** The steam turbine calculations have been updated to reflect the performance of more recent state-of-the-art steam turbine designs. Changes have been made to the implementation and application of the Spencer-Cotton-Cannon steam turbine performance correlations, sizing of the steam turbine, and selection of back-end steam turbine geometry for design and off-design performance estimates. In most cases, users will see improved steam turbine performance and higher section efficiencies in their combined cycle conceptual designs, resulting in higher power output at design conditions, when using Workstation default values.

  Off-design steam turbine performance estimates now also incorporate correlations based on the Spencer-Cotton-Cannon methodology. If the user chooses to specify the design point section efficiencies in lieu of Workstation-defined efficiencies, off-design performance will include the impact of off-design conditions on the user input design values.

- **Updated Combustion Turbine Performance Estimates.** The combustion turbine performance for the General Electric and some of the Alstom industrial frame machines have been updated based on manufacturer data. The performance for the other turbines in the CT library will be updated in the next service release.

- **Steam Turbine Design Point Sizing.** In addition to a more rigorous treatment of off-design performance estimates, the user now has additional flexibility in setting the design point for the steam turbine. Two new inputs have been added to the Site component worksheet – Ambient Dry Bulb Temp Basis for ST Design and Min Ambient Dry Bulb Temp with Duct Firing – to allow the user to specify operating points for which the steam turbine is to be sized. Steam cycle heat balance runs are performed for each of these two temperature bases, and the high-pressure (HP) steam production from these new runs will be compared with the performance point dry bulb temperature heat balance run. The operating point that yields the highest HP steam production will be deemed the steam turbine design run, and steam turbine sizing calculations will be based on this run. Subsequent runs of the heat balance will utilize the steam turbine calculations in off-design mode.

  Please note the following regarding the three candidate heat balance runs for which the steam turbine will be sized:

  1) The performance point run will include inlet air cooling and duct firing at the design condition if these technologies are included in the design.
  2) The Ambient Dry Bulb Temp Basis for ST Design run will not include inlet air cooling or duct firing when these technologies are included in the design.
  3) The Min Ambient Dry Bulb Temp with Duct Firing run will not include inlet air cooling if this technology is included in the design.

- **Sliding Pressure Steam Turbine Control.** Users can now select either throttled pressure or sliding pressure steam turbine control. Sliding pressure control allows for more efficient combined cycle plant operation during off-design conditions. The efficiency gains are a result of higher HP turbine internal efficiency, less boiler feed pump power consumption, and maintaining reheat steam temperature over a wider load range. Sliding pressure operation along with SOAPP-CT's periodic analysis feature provides the user with an accurate estimate of plant operation and its impact on the project cash flow and profitability.

One new input has been added to the Unit component worksheet – HP Pressure Control Method – to support this feature. The user may select one of the following four methods:

1) Full arc – sliding pressure
2) Partial arc – sliding pressure
3) Full arc – throttled
4) Partial arc – throttled

- **Multiple Steam Turbines and Single-Shaft Power Trains.** The SOAPP-CT conceptual design can now model multiple, identical steam turbines. Users may specify as many steam turbines as there are combustion turbines. This feature also extends to the single-shaft arrangement, where users can now model multiple HRSG-CT-GEN-ST power trains.

  One new input has been added to the Unit component worksheet – Number of Steam Turbines – to support this feature. Please note when multiple steam turbines are specified in the design, each steam turbine will have its own steam surface condenser (for once-through and wet mechanical draft cooling tower cooling system types). Air-cooled condensers and wet mechanical draft cooling towers will continue to be sized for the total plant heat rejection load.

- **Interstage Steam Attemperation.** Interstage attemperation is the most widely used means of controlling final steam temperature whether the design is supplementary-fired or unfired. This enhancement provides the user with the option to select either interstage or final attemperation for unfired configurations.

  One new input has been added to the Unit component worksheet – HP Steam Attemperation Location – to support this feature. The user may choose either Interstage or Final for the attemperation location, but the user should also note the following restriction:

  1) If duct burners are included in the design (whether Upfront or Interstage Duct Burner), the HP Steam Attemperation Location must be Interstage.

- **Steam Conditioning for Steam Turbine Extractions.** In addition to the pressure specification, users can now specify the temperature of the steam turbine extraction after conditioning with an attemperator/ desuperheater. Users can specify as many as four extractions from the steam turbine, where each extraction is at a different pressure/temperature condition.

Two new inputs have been added for each user-specified extraction – ST Extraction N Specify Temperature? and ST Extraction N Export Temperature, where N represents the extraction number (1 to 4).

If the extraction temperature is not specified, the temperature of the extraction (which will be referred to as the unconditioned extraction temperature) will be based solely on the expansion of the steam through the turbine stage up to the extraction pressure point. If the extraction temperature is specified and is lower than the unconditioned extraction temperature, the SOAPP-CT heat balance will condition the steam to the specified temperature by mixing with the appropriate amount of feedwater. Validation logic assures that the exported steam temperature cannot be specified higher than the temperature from the steam turbine or lower than saturated steam temperature.

- **Saturated Steam Export.** Saturated steam export is now available from the LP and IP evaporators. This feature, along with HRSG exports and steam turbine extractions, provides users with added flexibility in supporting designs with process steam requirements.

  For combined-cycle plant configurations, a superheated export flow is required before saturated steam export can be specified for that pressure level. This is to ensure that the superheater section is properly sized and used in the heat balance.

  For cogeneration plant configurations, recall that the unit input, Export All Available Flow must be set to Yes. For these configurations, the IP and LP superheated export flow inputs remain grayed out, but the user may specify the IP and LP saturated export flows. The difference between the available steam production for a pressure level and the saturated export flow is passed to the superheater section for superheated export.

  Note that the saturated steam export will be at the evaporator pressure. Since evaporator pressures are heat balance-calculated values based on the steam pressure (HP, IP and LP) inputs, the user may have to manually iterate on the IP and/or LP Steam Pressure input to achieve the desired saturated pressure. For the initial run, the LP evaporator pressure can be estimated to be 17% higher than the LP Steam Pressure input, and the IP evaporator pressure can be estimated to be 10% higher than the IP Steam Pressure input.

- **Parasitic Power Calculated on a Periodic Basis.** The periodic analysis provides the user with a good estimate of the off-design performance of the generating unit. These off-design cases may result in higher or lower parasitic power consumption than the design case, and the parasitic power calculation has been updated to capture these differences. Periodic calculation of parasitic power provides the user with an even better estimate of net plant output and heat rates, resulting in a more accurate financial analysis of the project.

- **Simple Cycle Emissions Control: CO and/or SCR Catalyst with Dilution Air Temperature Control.** Users can now evaluate the economic impact of operating simple-cycle units with CO and/or SCR catalyst. A conventional SCR with medium temperature catalyst can be included in the design criteria. If the CT exhaust gas temperature is above the catalyst's effective operating temperature range, a dilution air system will be added to the design to reduce the gas temperature accordingly.

  The existing Unit component input, SCR Configuration has been modified to include the following selections:

  1) None
  2) Conventional (with HRSG)
  3) Dilution Air (Simple Cycle)

  When the design conditions dictate that a dilution air system is required, it will consist of 2x100% dilution air fans per combustion turbine, air fan motors, air filters, and necessary ductwork and dampers.

- **Wet Mechanical Draft Cooling Tower with Plume Abatement Option.** This new cooling system option is a combination wet-dry system that can be specified for plants located near high traffic areas where visibility is critical (e.g. near airports and roads). This type of tower mixes dry air with the saturated air to reduce the moisture content in the total mixture before exiting the tower stack.

  The existing Unit component input, Cooling System Type has been modified to include a fourth option – WMDCT w/ Plume Abatement. Use of this technology will result in a larger tower (to accommodate the air heating/drying section), higher power consumption, and in a slightly higher discharge head on the circulating water pump. These differences are reflected in the equipment sizing, motor list, and capital cost reports..

- **Synchronous Clutch Option for Single Shaft Configuration.** For single-shaft arrangements, the user can specify if a synchronous clutch is to be included in the design. The addition of the clutch provides the plant with operational flexibility to operate the combustion turbine-generator separately from the steam turbine.

  The new Unit component input, Include Synchronous Clutch? can be set to Yes to include a synchronous clutch in the single-shaft design. If specified, the capital cost of the clutch will be included in the Steam Turbine and Accessories Cost Breakdown report.

  The user should confirm with the combustion turbine and steam turbine manufacturers that the synchronous clutch is an available equipment option if this option is selected in the conceptual design.

- **Updated Steam Table Functions.** The steam table functions in SOAPP-CT have been updated based on the corrections made in the ASME 1997 version.

- **Updated Balance-of-Plant Capital Costs.** Capital cost models, commodity estimates, and balance-of-plant equipment costs have been updated based on recent data from actual projects, commodity indices, and market considerations.

- **New Siemens Nomenclature.** In late-2004, Siemens Power Generation changed the naming convention on their combustion turbine product line (see below). The SOAPP-CT WorkStation continued to use the old naming convention because many of the existing users are more familiar with the old nomenclature. A note has been added in the CT Dialog Box for each specific Siemens turbine providing the new naming convention.

Old Name	Gas Turbine Only	Gas Turbine Package	Simple Cycle Plant	Combined Cycle Plant
V64.3A (60Hz)	SGT6-1000F	SGT6-PAC 1000F	SCC6-1000F	SCC6-1000F
V84.2	SGT6-2000E	SGT6-PAC 2000E	SCC6-2000E	SCC6-2000E
W501D5A	SGT6-3000E	SGT6-PAC 3000E	SCC6-3000E	SCC6-3000E
V84.3A	SGT6-4000F	SGT6-PAC 4000F	SCC6-4000F	SCC6-4000F
W501FD	SGT6-5000F	SGT6-PAC 5000F	SCC6-5000F	SCC6-5000F
W501G	SGT6-6000G	SGT6-PAC 6000G	SCC6-6000G	SCC6-6000G
Announced	SGT6-8000H	SGT6-PAC 8000H	SCC6-8000H	SCC6-8000H
V64.3A (50 Hz)	SGT5-1000F	SGT5-PAC 1000F	SCC5-1000F	SCC5-1000F
V94.2	SGT5-2000E	SGT5-PAC 2000E	SCC5-2000E	SCC5-2000E
V94.2A	SGT5-3000E	SGT5-PAC 3000E	SCC5-3000E	SCC5-3000E
V94.3A	SGT5-4000F	SGT5-PAC 4000F	SCC5-4000F	SCC5-4000F
Announced	SGT5-8000H	SGT5-PAC 8000H	SCC5-8000H	SCC5-8000H

The following example shows how the new model name has been derived for the W501FD package.

S	GT	6	-	PAC	5000	F
Siemens						
	Scope or Product (GT, CC, ST, etc.)					
		Frequency (5 or 6)				
				Package (if within scope)		
					Output Range	
						Technology Class

A portion of the Alstom combustion turbine product line was purchased by Siemens Generation and the naming convention was also changed. The Typhoon, Tornado, Tempest and Cyclone are not currently modeled in the SOAPP-CT WorkStation, but they are included in the SOAPP-CT.25 WorkStation (one of EPRI's distributed generation software applications).

Old Name	Gas Turbine Only	Gas Turbine Package
Typhoon	SGT-100	SGT-PAC 100
Tornado	SGT-200	SGT-PAC 200
Tempest	SGT-300	SGT-PAC 300
Cyclone	SGT-400	SGT-PAC 400
GT35	SGT-500	SGT-PAC 500
GT10B	SGT-600	SGT-PAC 600
GT10C	SGT-700	SGT-PAC 700
GTX100	SGT-800	SGT-PAC 800
W251 (B11 & B12)	SGT-900	SGT-PAC 900
V64.3A	SGT-1000F	SGT-PAC 1000F

All SOAPP software products are designed for Microsoft Windows™. SOAPP-CT operates under Windows 2000 and Windows XP (and former OS such as Windows 95, 98, ME and NT).

EPRI provides power generation technologies, products and services focused on providing clients with a competitive edge in a rapidly evolving energy industry. The SOAPP Team develops and markets the award-winning SOAPP family of commercial software products and consults with clients around the world to identify and evaluate strategies, evaluate new power generation and repowering alternatives, and provide risk mitigation for applying advanced competitive technologies.

The award-winning SOAPP® products, originally developed by Sargent & Lundy of Chicago, IL. incorporate technology developed for the electric power industry under the sponsorship of the Electric Power Research Institute (EPRI), based in Palo Alto, CA. All commercial SOAPP products are developed, supported, and maintained by the SOAPP Team at EPRI.

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