Welcome!

Webinar #10. Supplementary Firing & Control Loops in GT PRO/GT MASTER

August 31, 2017

The webinar will be starting on time (10:00 EDT)

Host: Meritt Elmasri (US office)
Presenter: Evgeny Zakharenkov
Thermoflow Training and Support

- Standard Training
- On-site Training course
- Advanced Workshop
- Webinars when new version is released
- Help, Tutorials, PPT, Videos
- Technical Support

→ Feature Awareness Webinars
Agenda

• Designing plants with supplementary firing
• HRSG with radiant surfaces
• Control Loops in GT MASTER
Designing plants with supplementary firing

When supplementary firing is used

• Flexible steam production and power output of the steam turbine.

• Flexible cogeneration plants for steam and hot water production.

• Compensation for changing ambient conditions (stabilizing steam temperature and mass flow rate).
GT PRO / GT MASTER allows to have up to two duct burners.

Net Power 169771 kW
LHV Net Heat Rate 7078 kJ/kWh
LHV Net Efficiency 50.86 %
How to set duct burners
Changing location of the duct burner

*Switch to user-defined and drag duct burners to new locations
Plant model sample with supplementary firing

- Combined cycle based on 2xGE 6F.01.
- Supplementary firing (up to 750°C) to produce more power when electricity price is high.
Plant model sample with supplementary firing

Net Power 168541 kW
LHV Net Heat Rate 6833 kJ/kWh
LHV Net Efficiency 52.69 %

Includes DB

Super Heaters undersized
Plant model sample with supplementary firing
Supplementary firing 750 C
No supplementary firing
HRSG with radiant surfaces

• When the gas temperature is higher than 800 °C the radiant heat exchange takes place.

• Radiant heat exchanges have to be used in this case (screens).
HRSG with radiant surfaces
HRSG with radiant surfaces

Placing into radiant zone
HRSG with radiant surfaces
Control Loop in GT MASTER

- Control Loop is a tool for automatically searching for the values of inputs to the GT MASTER model that cause an output of the GT MASTER model to attain a certain, desired value.
Control Loop in GT MASTER

Control Loop Menu

GT MASTER 25.1 - Control Loop Menu

Current Control Loop Configurations

- Set Point: Plant net output
  - Desired value: 140000 [kW]
- Primary control: GT load percentage
  - From: 50 to 100 [%]
- Upper control: Duct Burner exit temperature
  - From: 500 to 750 [°C]
- Lower control: None

Select Set Point or Control Variables

- Set Point variables
  - None, Plant gross output, Plant net output, Steam turbine generator output, Plant gross heat rate, Plant net heat rate, Plant gross electric eff, Plant net electric eff, Gas turbine gross output, PURPA efficiency

Tolerance: 0.02 [%]

Click on the list box to select Set Point variable. GT MASTER will iterate on Primary Control variable, and Upper or Lower Control variable if necessary, to achieve the desired set point value.
Control Loop in GT MASTER

Control Loop Results (140 MW)

The control loop set point has been achieved by activating your Primary Control alone.
Control Loop in GT MASTER

Control Loop Results (155 MW)

The control loop set point has been achieved by activating both your Primary and Upper Controls.
Control Loop in GT MASTER

Control Loop is available input for ELINK

<table>
<thead>
<tr>
<th>INPUT VARIABLE DESCRIPTION</th>
<th>Units</th>
<th>Base Case</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
<th>Case 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant net output</td>
<td></td>
<td>170000</td>
<td>90000</td>
<td>110000</td>
<td>130000</td>
<td>150000</td>
<td>170000</td>
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</tr>
</thead>
<tbody>
<tr>
<td>Plant net output</td>
<td>kW</td>
<td>167,494</td>
<td>89,995</td>
<td>110,005</td>
<td>129,994</td>
<td>149,999</td>
<td>167,494</td>
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<td>GT load</td>
<td>%</td>
<td>100.0</td>
<td>54.47</td>
<td>69.98</td>
<td>85.9</td>
<td>100.0</td>
<td>100.0</td>
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<tr>
<td>Total duct burner fuel flow</td>
<td>t/h</td>
<td>3.335</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.2547</td>
<td>3.335</td>
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<tr>
<td>Duct burner exit temperature</td>
<td>C</td>
<td>750.0</td>
<td>647.1</td>
<td>638.2</td>
<td>620.7</td>
<td>516.0</td>
<td>750.0</td>
</tr>
</tbody>
</table>
Q & A session

Please send your questions to the presenter in the webinar chat!

For further questions: zakharenkov@thermoflow.com
Thank you!