Exploring Sigmafine Energy Balance Application

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A member of CSE global

Sigmafine Users Conference
San Francisco, April 26, 2010

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Agenda

- What do we have to begin with?
- What do we need?
- What have we done so far?
    - The Steam Table DR
    - The Flue Gas DR
- Putting the pieces together
- What can we do next?

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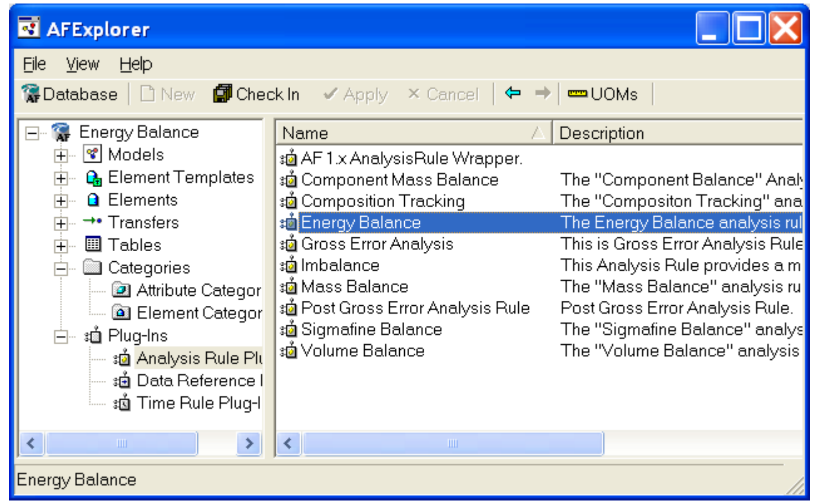
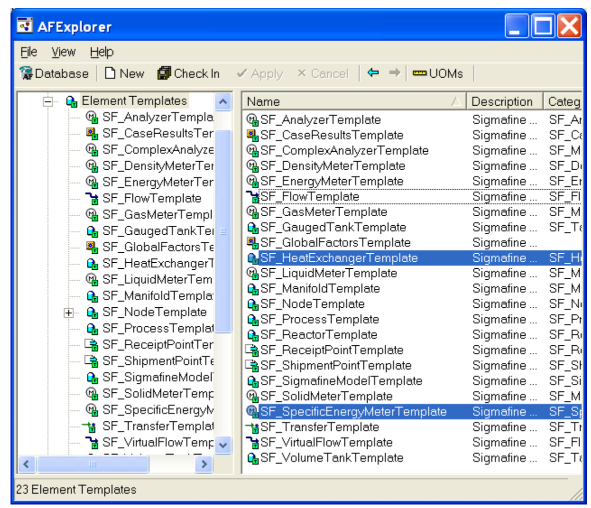
What do we have to begin with?

- Sigmafine Energy Balance Analysis Rule
  - Sigmafine Reference Manual – Appendix L
  - Heat Exchanger Templates
  - Specific Energy Templates
  - Other essentials like Process, Nodes, Flow, Meters Templates

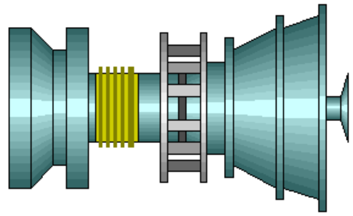




What do we need?

- More Heat/Energy Transfer Equipments Types
  - Boilers, Turbines, etc

- Energy Calculations
  - Performing Energy Balance requires sufficient energy measurements so that the model is at least solvable
  - Besides power plants MW measurement, production plants do not measure energy directly

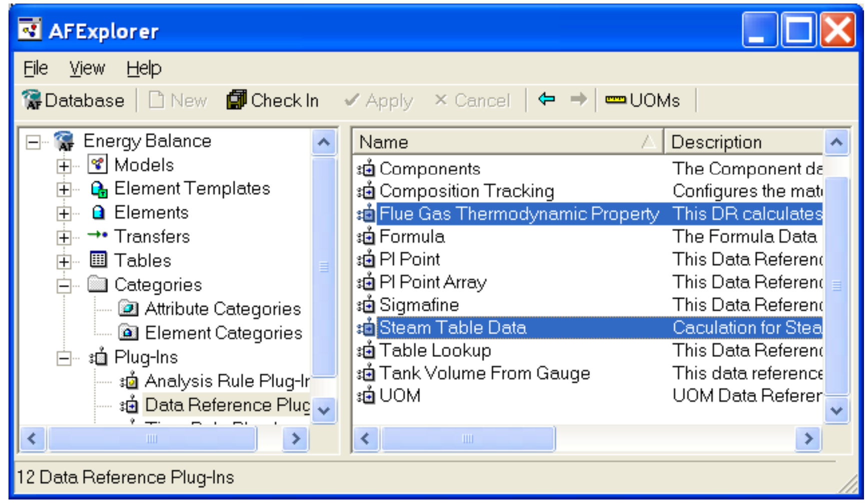


$$P_r = P_t \int \frac{\lambda^2 g_t g_r}{(4\pi)^2 r_1^{\,2} r_2^{\,2}} \sigma \, dV$$

What have we done so far?

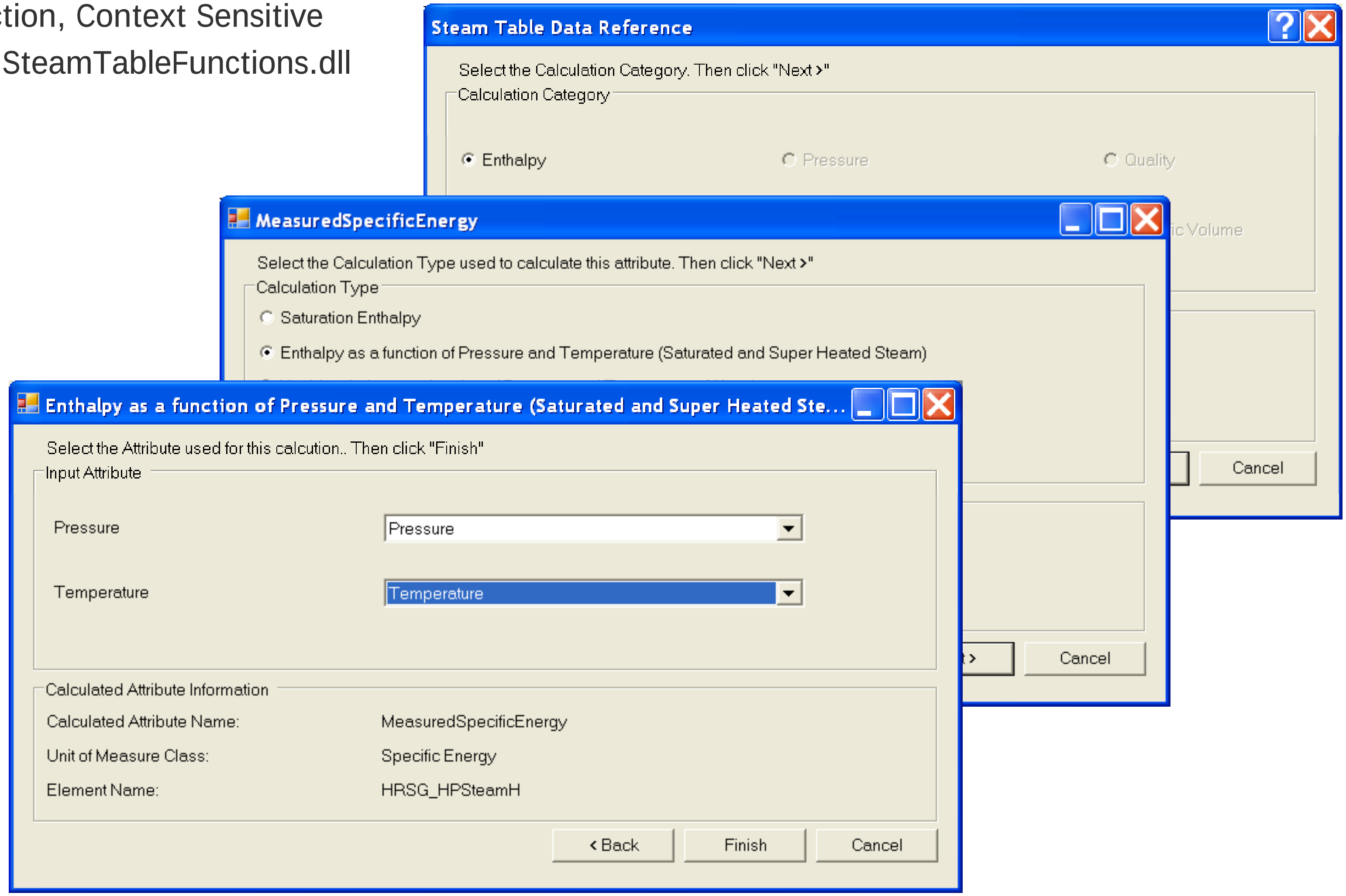
- Created a Steam Table Data Reference
  - Most common medium in the industry for heat transfer
  - To be used in Specific Energy calculation

- Created a Flue Gas Property Data Reference
  - Useful to model the process side of heat transfer equipments
  - To be used in Specific Energy calculation



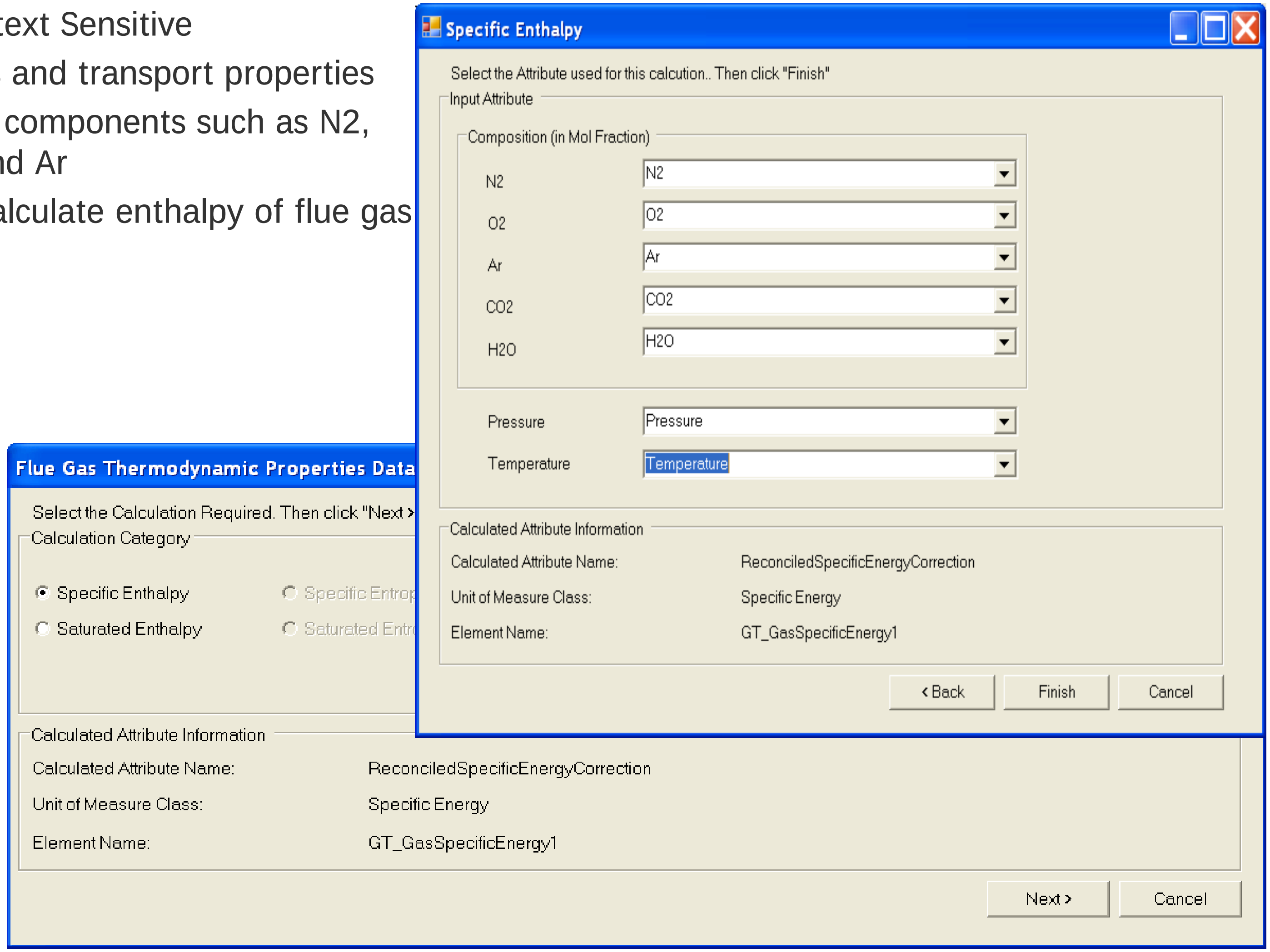
The Steam Table DR

- Full Function, Context Sensitive
  - Uses PISteamTableFunctions.dll



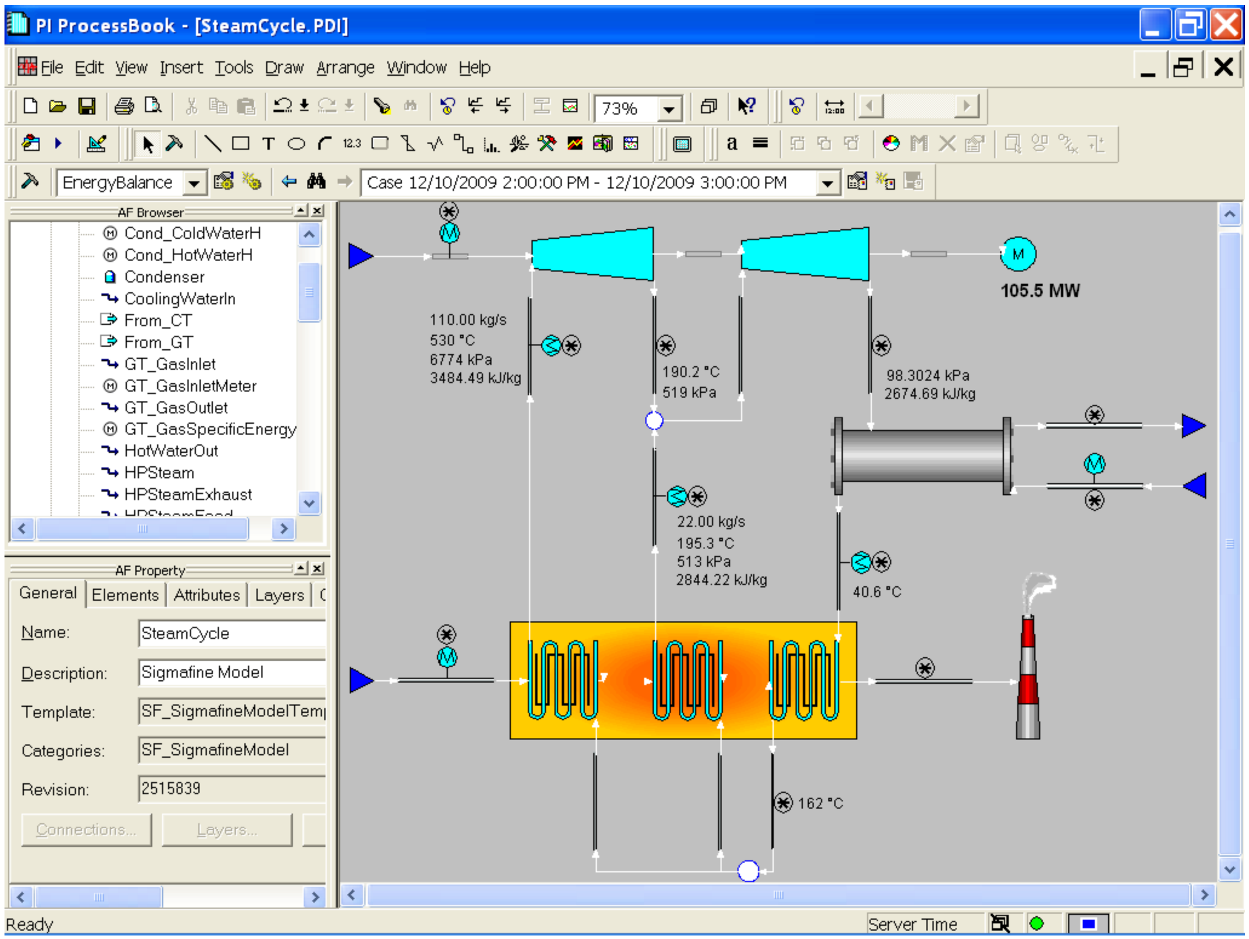
The Flue Gas Properties DR

- Full Function, Context Sensitive
  - Thermodynamics and transport properties
  - Base on flue gas components such as N_2, CO_2, H_2O, O_2 and Ar
  - Mainly used to calculate enthalpy of flue gas



Putting the Pieces Together

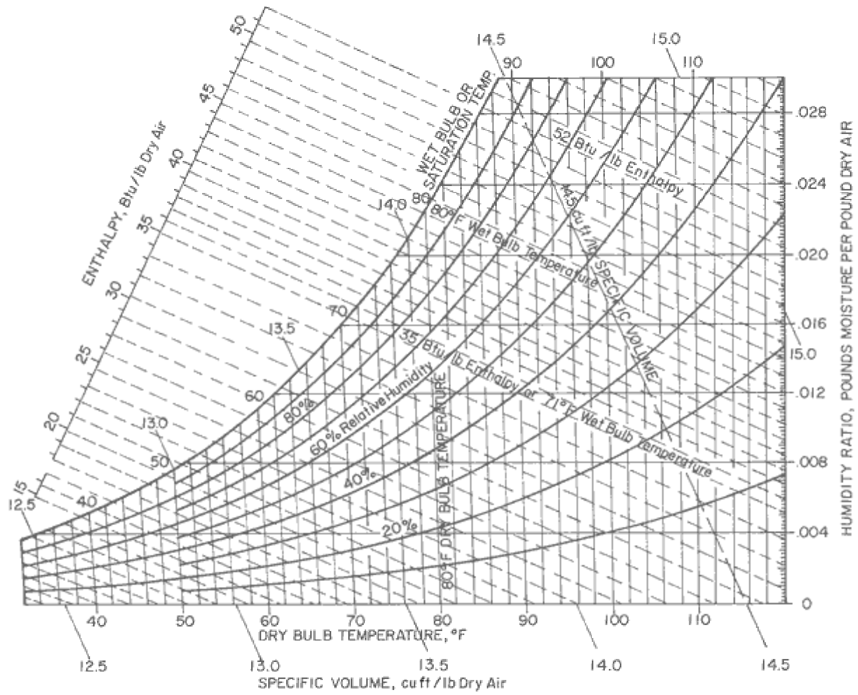
- Some improvisation
  - Use heat exchanger template for all heat / energy transfer equipment
  - Use pseudo flows to mimic removal of energy from steam turbine



What can we do next?

- Develop combustion calculations
  - Consider using Formula DR; or a custom DR
  - Calculate mass and energy balance around combustion process
- Develop air properties DR
  - Support combustion calculations
  - Enable ambient conditions to feature in the model
- Build more details for each piece of equipment to reflect actual plant configurations
- Build KPI calculations
  - Heat rate, equipment efficiency, etc

$$CH_X + (1 + \frac{X}{4})\, O_2 \rightarrow CO_2 + \frac{X}{2} H_2O$$



$$\text{Efficiency (in \%)} = \frac{P_{out}}{P_{in}} \times 100$$

Thank you

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