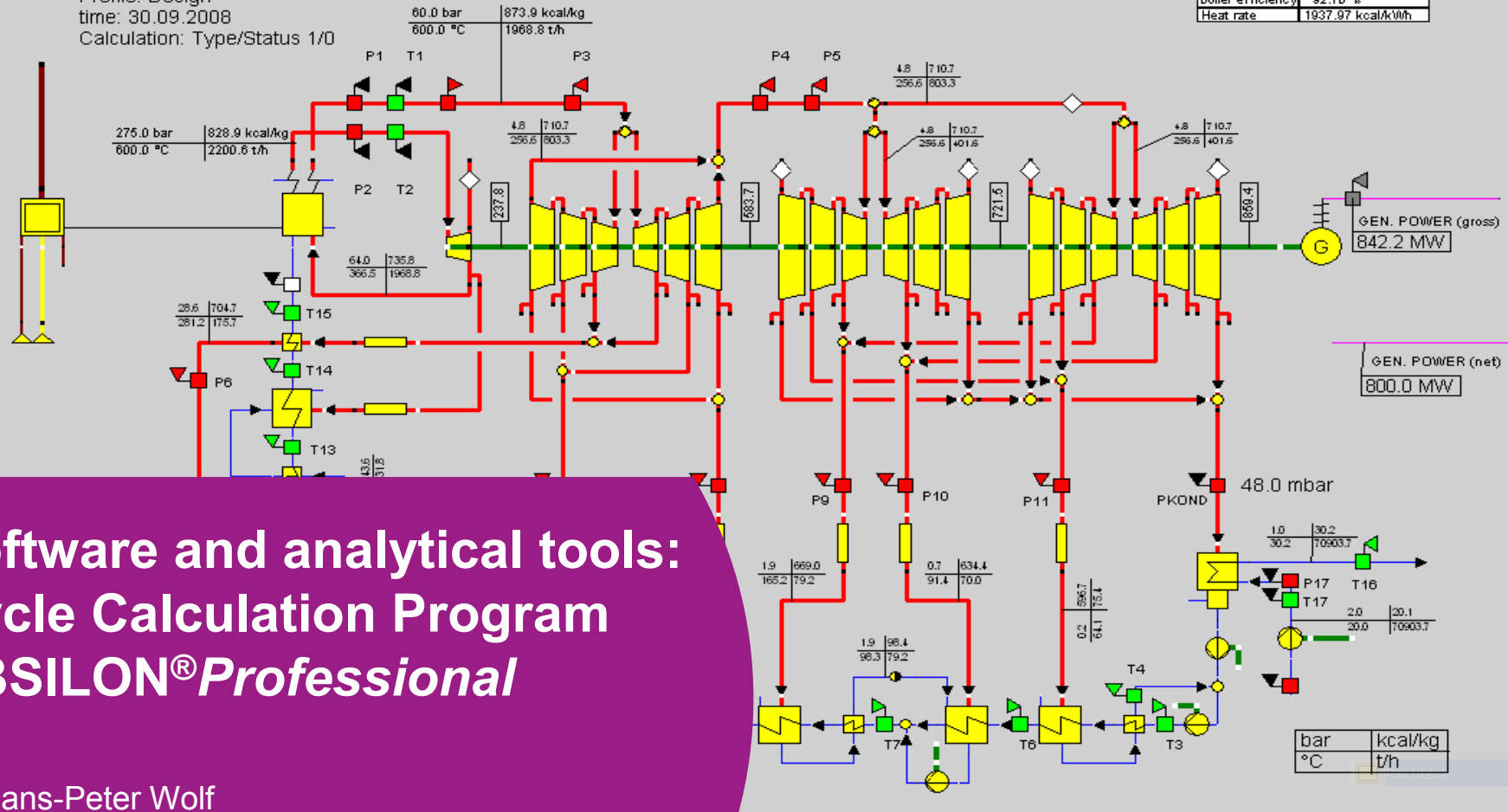


Water Steam Cycle of a 800 MW plant

model: BLOCK800
 Design / Off Design (0/1): 0
 Profile: Design
 time: 30.09.2008
 Calculation: Type/Status 1/0

Plant Economy	
Gross power	842.22 MW
Net power	800.00 MW
Gross efficiency	46.71 %
Net efficiency	44.37 %
boiler efficiency	92.70 %
Heat rate	1937.97 kcal/kWh



Software and analytical tools:
 Cycle Calculation Program
EBSILON®Professional

Dr.Hans-Peter Wolf
 1.10.2008



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Overview



- Features of the calculation program
- Component library
- Fluid library
- Steps in power-plant mapping (with practical demonstration)
- Mapping of power-plant in detail
- Offline / Online application
- Data-Reconciliation (with practical demonstration)
- Introduction CD

Features of the calculation program



EBSILON®Professional is the tool for the stationary simulation of all kinds of thermal power and refrigeration cycles :

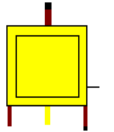
- Fossil power plants (hard coal fired, lignite fired, oil fired, gas turbine)
- Nuclear power plants (NPP)
- Combined cycle power plants (CCPP)
- Combined heat and power plants (CHP)
- Regenerative energy (Solarthermal, Geothermal, Biomass...)
- Additional working fluids (ORC, certain binary mixtures)
- Desalination processes (MFD)
- Refrigeration cycles

Features of the calculation program

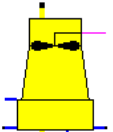


- **User friendliness** by intuitive handling (100 % Windows compliant)
- **No programming** skills required
- **Graphical objects** for components and pipes (component library and fluid library)
- Complete observance of **physical laws** (mass-balance, energy balance, ...)
- **Design** and **off-design** calculation possible
- Extension by **self-defined macros** and by **DLLs** possible
- Large number of **different fluids**
- **Fast diagnosis** of topology and specification errors
- **High stability of convergence** of solution
- Different **unit systems**

Component library



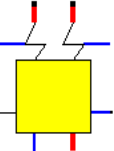
Furnace



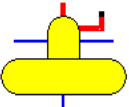
Cooling tower



Valve



Steam generator



Feedwater tank



Splitter



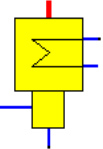
Turbine



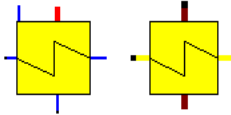
Compressor



Mixer



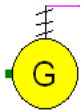
Condenser



Heat exchangers



Pipe loss



Generator

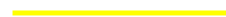
















Pump + motor

altogether approximately 100 different components

Fluid library



	Air		Oil		User-defined Fluid
	Fluegas		Coal / Ash		
	Water		Gas		
	Steam		Shaft		
	Saltwater		Electrical		
	2-phase liquid		Reference value		
	2-phase gaseous		Logical		

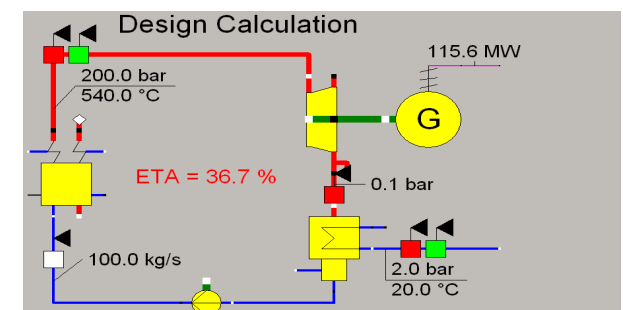
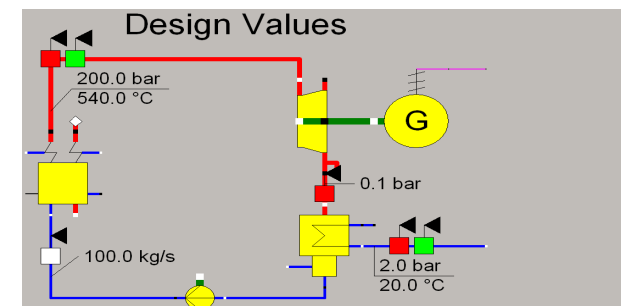
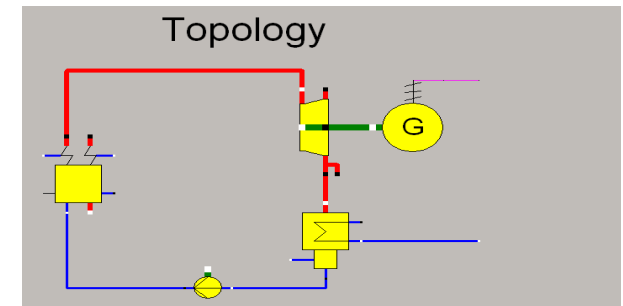
Composition of gases and fuels can be defined

library with more than 80 different fluids

The type of the pipeline (“color”) defines the fluid which is transported through the pipe

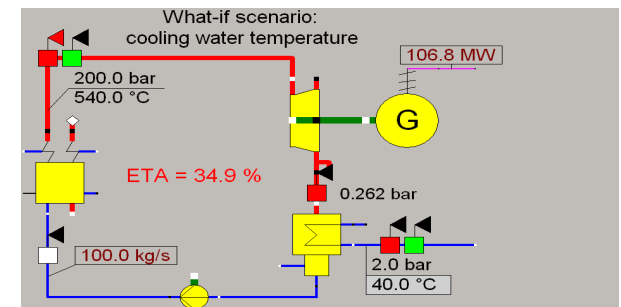
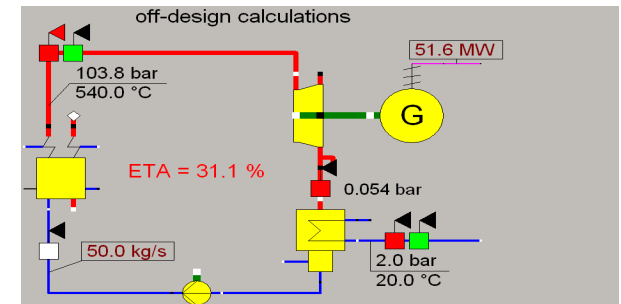
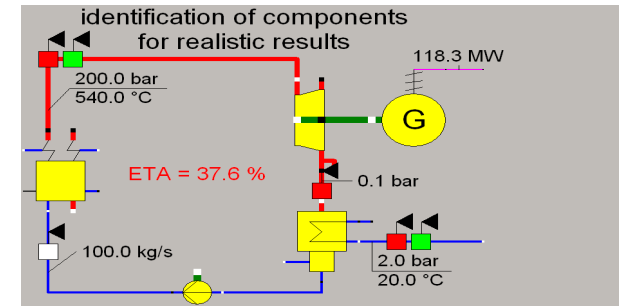
Steps in power-plant mapping

- **Create the topology**
(from component library and fluid library)
- **Specify the design values**
(values of the 100 % plant condition at default ambient condition)
- **Do a design calculation**
(simulate the 100 % plant condition)

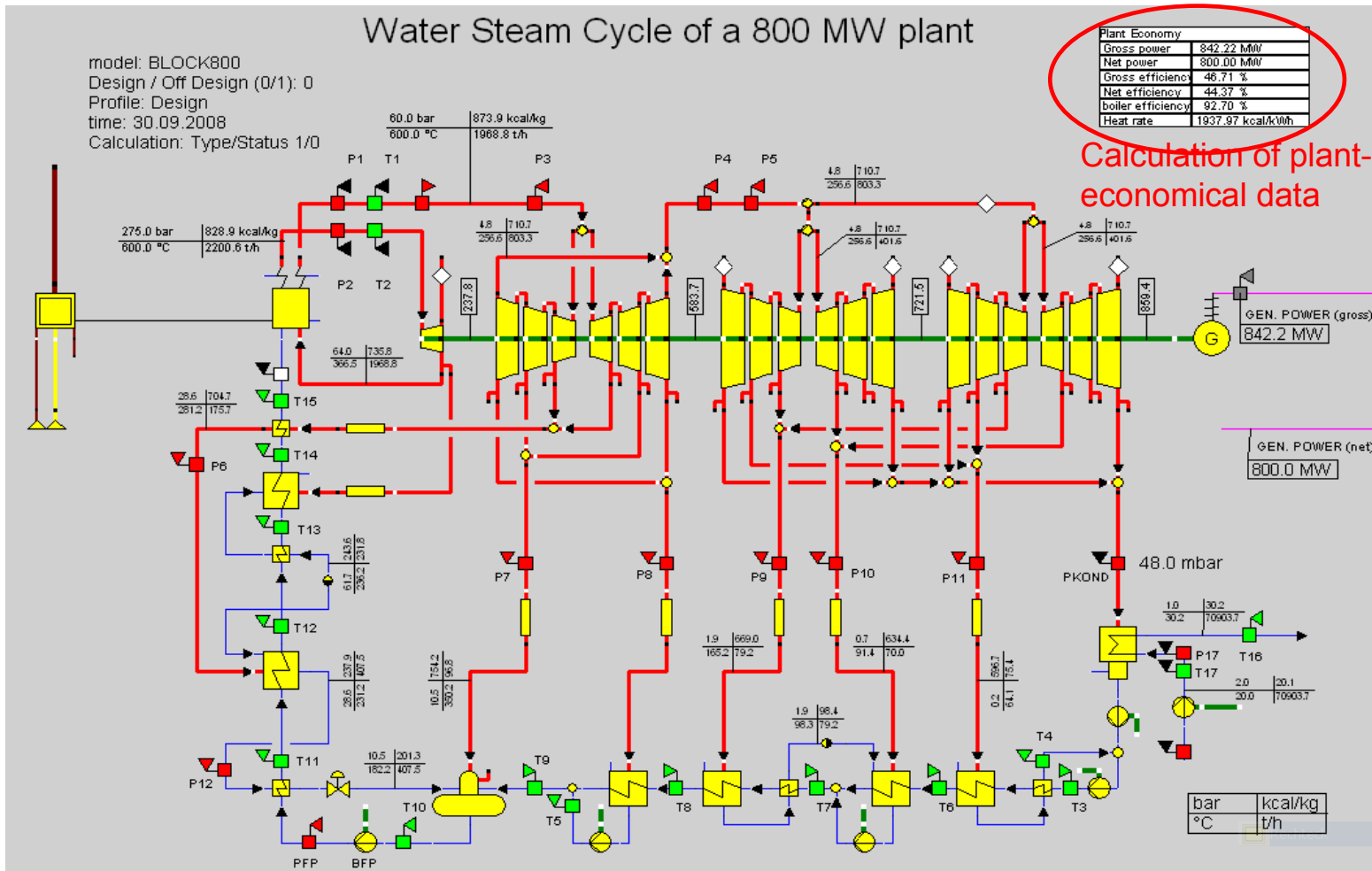


Steps in power-plant mapping

- **Identify components**
(i.e. adjust nominal values and partload performance characteristics of components from default values to “real” values.
Derive the “real” values from manufacturers data, heat- balance diagrams or from measurements)
- **Do off-design calculation**
(values for different load-cases)
- **Do What-If scenarios**
(investigate the behaviour of the model under different conditions)



Mapping of power-plant in detail



Study case: Detailed mapping of Water Steam Cycle of a 800 MW supercritical power plant

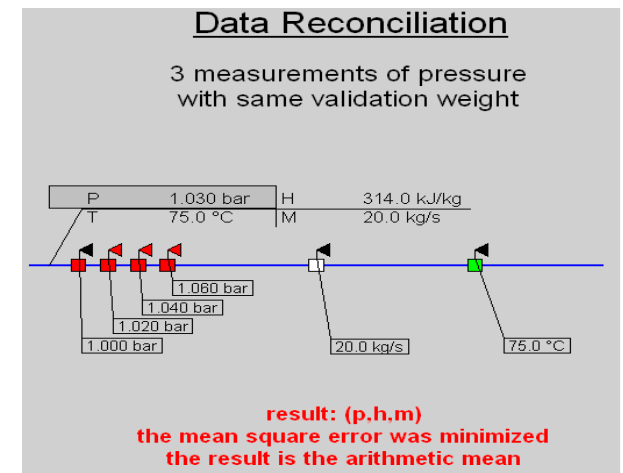
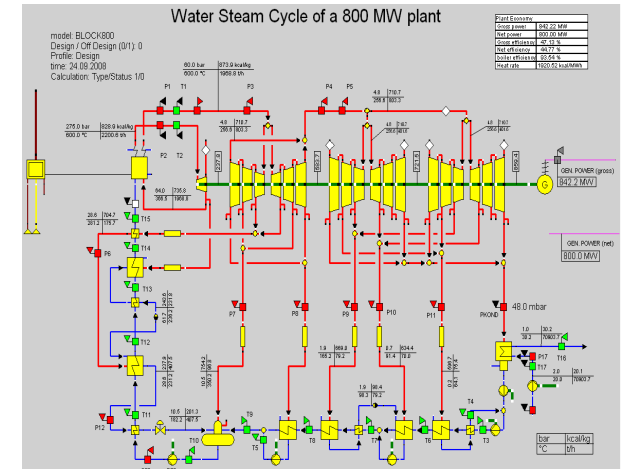
Offline / Online application

The calculation tool can be used for **offline applications** :

- Design of thermal power cycles, optimization of design
- Research tool
- Mapping of existing power plants
- Calculation of What-If scenarios (retrofit, ...)
- ...

The calculation tool can be used for **online applications** :

- Data reconciliation
- Performance monitoring
- Optimisation of power-plant operation
- ...



Data Reconciliation



In an Online-application the Data Reconciliation can be used to improve the mass- and heat-balance calculation of the power-plant. This leads to :

- Detection of measurement errors
- More accurate performance monitoring of components
- Higher confidence in the results of the Online-calculation
- Better basis for Online What-If calculations and for calculating monetary losses

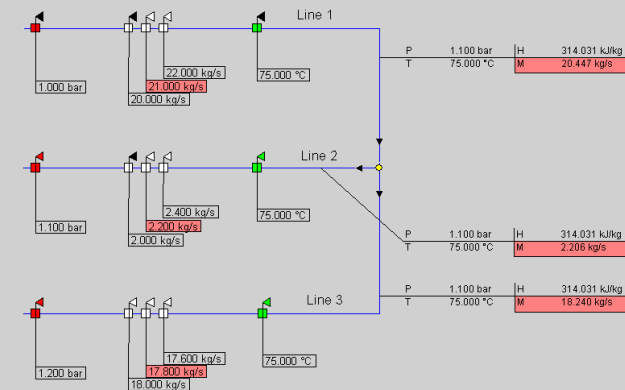
Data Reconciliation



Data Reconciliation uses the method of minimizing the mean square error :

- In simple cases it means averaging redundant measurements
- Measurements can have different individual “weights”
- But data reconciliation is not just averaging. Physical balance equations for mass and energy are obeyed

In EpsilonProfessional a validated solution (pressure, flow, enthalpy) is computed for all pipes. All physics equations (conservation of mass and energy) are observed.



result:
set of variables (P1, ... M3), which observes all physics equations
AND minimizes the mean square error

It is NOT simple averaging

Introduction CD



There exists an “Introduction CD” :

- The “Basic Introduction” describes the steps in power-plant mapping (as shown before)
- The “Advanced Introduction” describes features like :
 - EbsScript (programming language)
 - Import / Export to/from Excel
 - Diagrams (h-s, T-s, Q-T, ...)
 - Adaption polynomials
 - Optimization
 - Boiler components

It is recommended that you study the material contained in the Introduction CD !





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