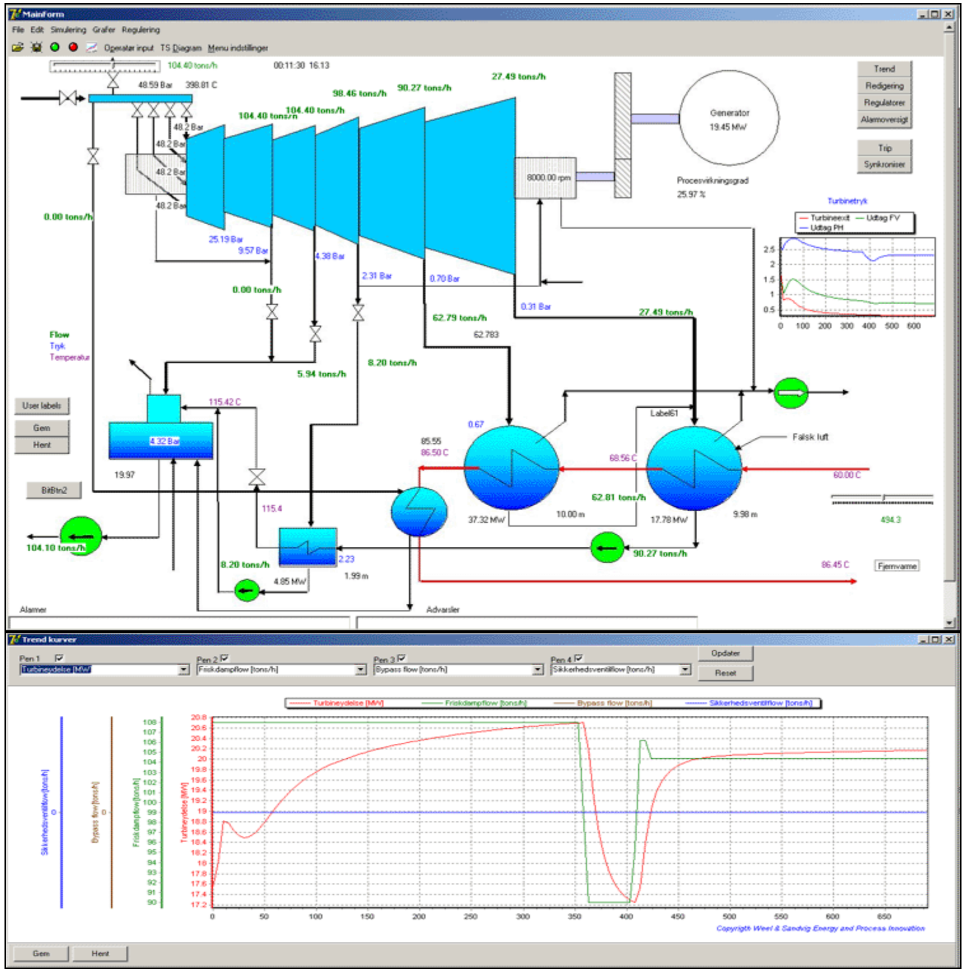
Weel & Sandvig
ENERGY AND PROCESS INNOVATION

WS.SteamTurb-simulator

Steam turbine simulator

- for analyses and training of staff in waste-to-energy plants,
power plants and industrial applications

Weel & Sandvig has released a simulator of a steam turbine system. The main purposes of the simulator are training of operating personal and to analyze the plant response to incidents and operability during transients.



Main screen of the WS.SteamTurb-simulator with trend curves.

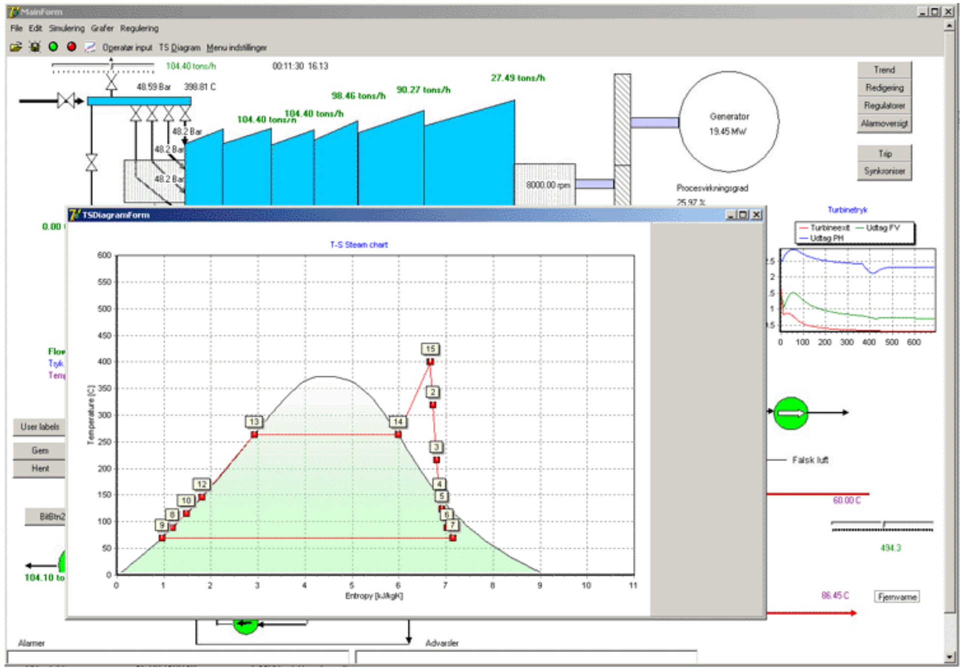
The simulation model includes the turbine governor control, steam extraction control, feedwater preheating, district heating condenser, bypass control, liquid level control in condensers and preheaters, steam seal system and vacuum system. Normally, the simulator will be reconfigured according to the actual plant specifications. A few examples of situations to be analyzed are:

- Starting and synchronizing and loading of the steam turbine and generator.
- Response from trip of district heating pumps.
- Response from high district heating return temperature.
- High water level in condensers.
- Generator trip.
- Failed vacuum pump or steam seal system.

So far and among others the simulator has been used for:

- Training of operating personal (what happens when? and what to do? analyses).
- Test of critical incidents.
- Analysis and improvement of control parameters.

As a feature, the simulator includes a TS-diagram of the momentary Rankine cycle, constantly being updated.



The momentary Rankine cycle in a T-S diagram presented and updated while the simulation runs.

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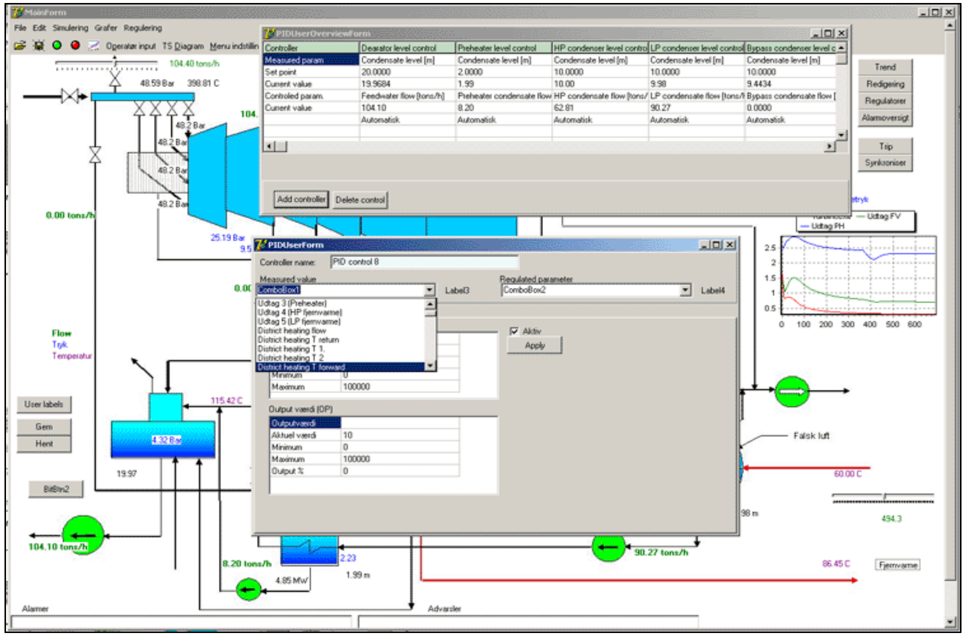
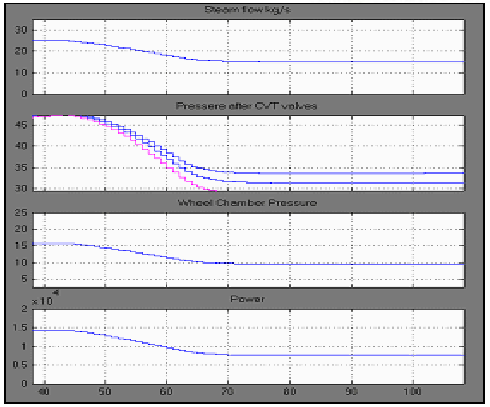
As an option, the user can change the control system of the simulator. All the controllers of the simulator can be presented on a table form and controllers can be removed and new ones defined.
When defining a new controller, the user picks the variable to control (target and measured variable) from a drop-down menu among all available. Next step is to pick, from another drop-down menu the parameter to adjust in order to control the first variable selected.



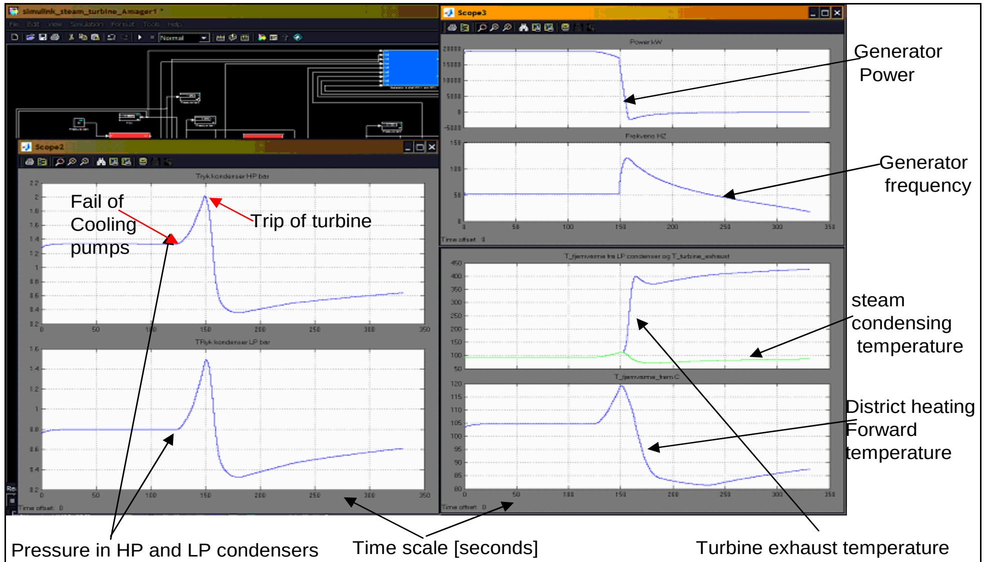
Window for defining or changing controllers.



Example of transients during a load change by changing position of the control valves (CVT). The figure shows mass flow of steam, pressure after CVT, pressure in wheel chamber and generated power.

On top on the next page the transients in steam mass flow, pressure after CVT, pressure in wheel chamber and power are seen during load reduction by changing position of CVT.

At the bottom of the next page the incident from a failure of the district heating pumps and the behavior of parameters in the steam turbine have been investigated.
The flow rate of the district heating pump is decreased from 325 kg/s to 10 kg/s within 10 seconds. During the time following the pressure in the condensers will rice to the turbine trip level and causing the turbine to trip by fast closing the governor.



Simulation of a steam turbine with two district heating condenser during a failure of district heating pumps .
The district heating pumps fail at t=125 seconds. The condenser pressure is rising to the turbine trip level at t = 150 seconds. The Turbine is disconnected to the grid and the main governor (emergency valve) is closed within the following 0.5 sekunds. The evolutions of the parameters could be seen from the figure. From the simulation result it could be concluded that the plant emergency air cooler system should be able to deliver cooling water with in 20 sekunds to prevent a turbine trip.

Example of turbine plant response after a trip of the district heating pumps.

For questions or more information please feel free to contact:

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