Added Values

MODELICA – FOR DYNAMIC ANALYSIS & DESIGN

Modelica is our preferred tool for dynamic analyses and process control design.
In real life, all processes are dynamic. I.e. they have an inherent reluctance to change momentarily – such as when you step on the accelerator and the car accelerates.

Dynamic analysis

In Modelica, we carry out dynamic process analyses in virtually all domains – thermo-hydraulic, electrical, mechanical, chemical, etc.

We have analysed areas such as:

- How long it takes for the various heating surfaces of a woodchip boiler to cool below 150 °C following a power outage.
- Which components and processes of an electrode boiler inhibit load changes in less than 30 seconds (see Figure 1).
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- How quickly the room temperature drops to -20 °C in a heat pump building in case of a CO2 leak.
- Causes of steam pressure oscillations between a boiler and a steam turbine.

Since 2013, we have designed and developed our own libraries of reusable components compatible with third-party Modelica libraries.

In addition, we use several third-party libraries, and we thus benefit from other people's knowledge and models. This enables us to quickly set up models of new plants and processes, and to increase the level of detail as needed.

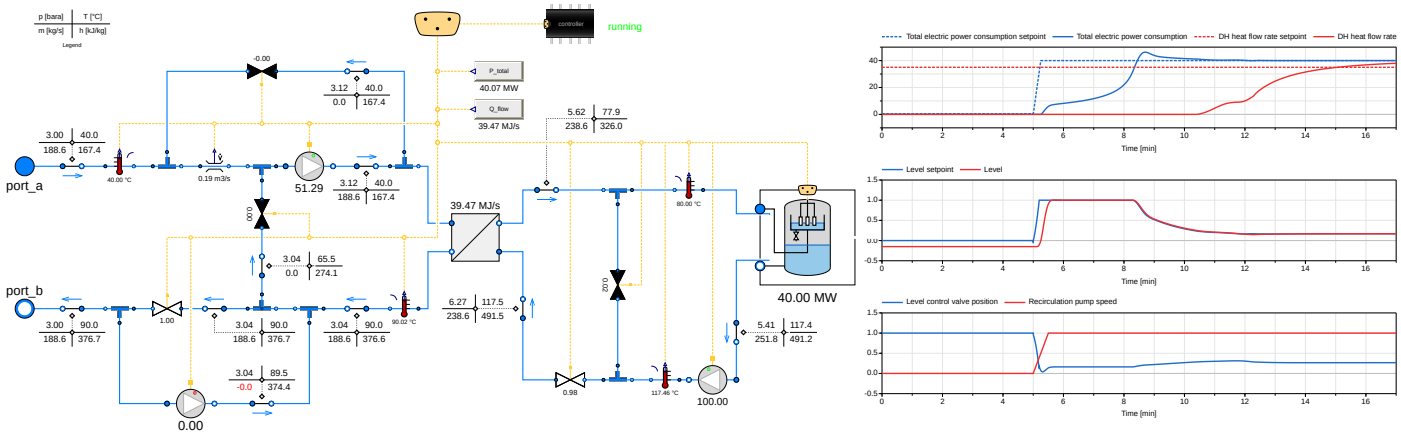

Figure 1 : *model of an electrode boiler with associated components and control. The graph shows details from a cold startup*

Control system design

When we design control systems – i.e. continuous and sequential control, etc. – we always use dynamic process models to test and validate the control design – as a form of checklist. We thus expose the model of the closed-loop system in question to all possible scenarios, e.g.

- Startup/shutdown
- Load changes
- Operator intervention
- Failure situations

By rigorously desktop testing our design, we minimize the risk of transferring design errors into the real process when commissioned.

As our models are usually hierarchical, we can hide details in subcomponents to maintain the overview. When a model is analysed, we can dive into the layers and scrutinize the inner workings of the model.

In Modelica we design control systems such as:

- Pump group controllers – two pumps can be controlled so they appear as one pump (see Figure 2).
- Master controller and electric power management system for ancillary service activation across power-to-heat units.
- Control of water treatment plants – coordination of water flows through filters, tanks, ion exchangers, etc.
- Control strategy for the utilisation of several heat storage tanks – storage of district heating energy with different temperature levels.

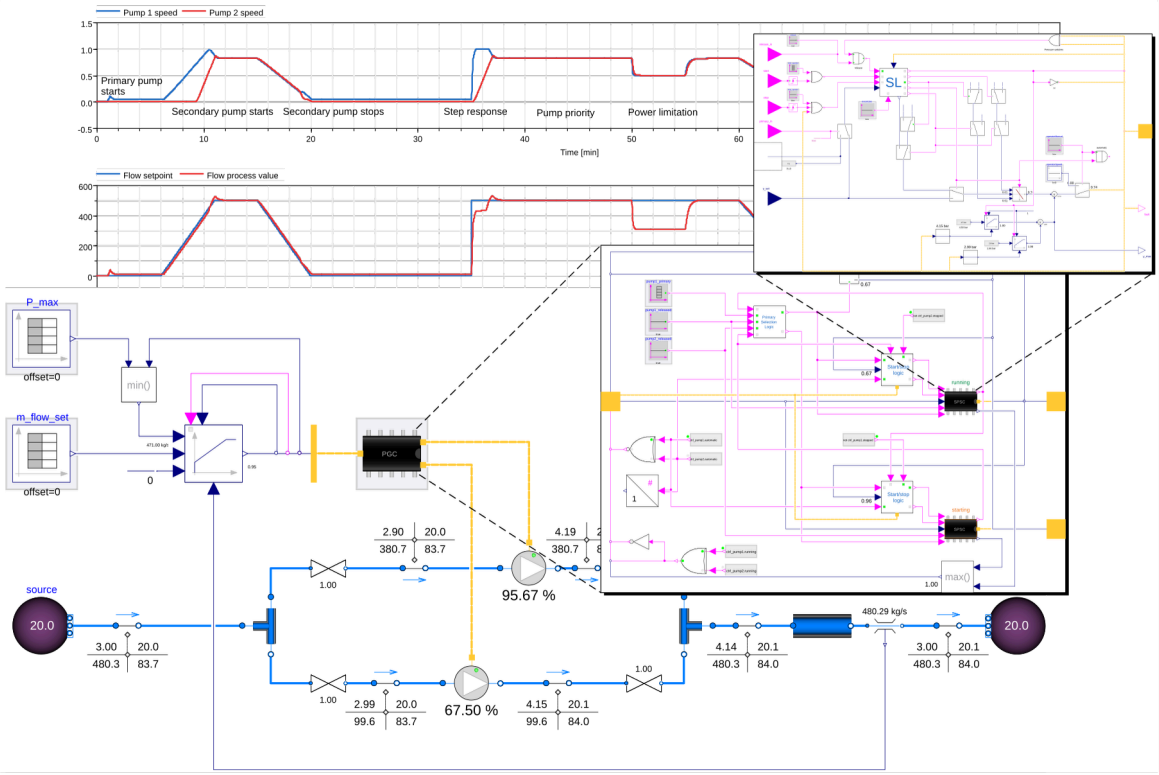

***Figure 2**: Simulation of a pump group controller. The graph shows the startup and shutdown of two parallel pumps. In dashed lines, the diagrams show how you can dive into the details of the model.*

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