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# Striving for Operational Excellence: A Holistic Approach through Dynamic Study & Performance Test

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**Abstract:**

*This paper details a case study of the project at Iggesund Paperboard, Sweden, where an innovative holistic methodology was used to carryout dynamic simulation studies and comprehensive testing of an Integrated Steam and Power System network. The primary objective is to identify and address system bottlenecks, leading to improved productivity and increased reliability with a short RoI of less than 6 months.*

## Introduction

Iggesund Paperboard, the Top-Quality Board producer, situated on the east coast of Sweden highly recognizes their steam net pressures as: "Steam Net pressures are essential to product quality". Solvina was asked to design and tune the steam net control before the complex installation of a new boiler and a new turbine as shown in Figure-1.

The plant was going for modifications with an installation of:

- New recovery boiler
- New steam header HT1 at 110 bar
- New back pressure turbine with several extractions (replaces two existing turbines)
- Steam reduction valves.

Solvina was asked to Design & tune Steam Net Control for:

- Large steam load transients
- Turbine trip
- Start/stop of large electric motors in Island Operation.

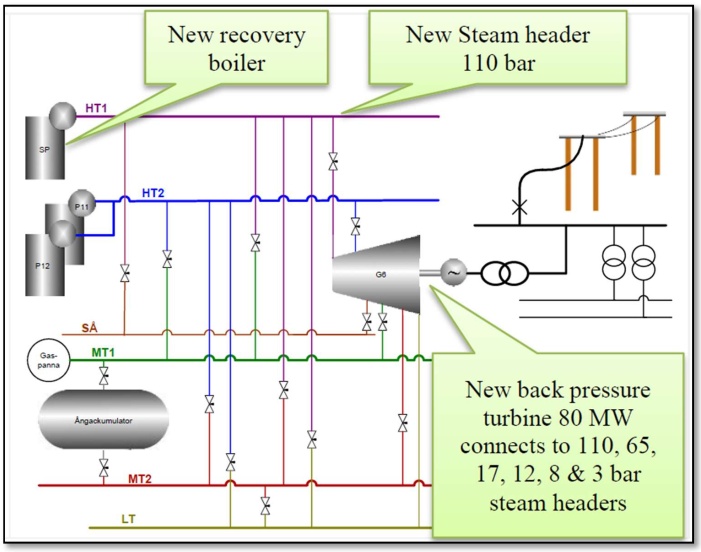


*Figure-1: Plant configuration after new installations*

## Purpose

The purpose was to assure an efficient and safe commissioning as well as a well-functioning plant and trained operators for all operational transients at the installation of new recovery boiler and turbine.

The following scope of work was carried out:

- Design of Steam Net Control (3 boilers, turbine with 6 valves, 35 bypass valves) for steam pressure and steam temperatures during all transients.

- Simulation of all transients with model describing thermodynamics and electrical power system.
- Training of operators with training simulator for different emergency situations.
- Test of island operations capability.

## Method

Boilers, the turbine with several extractions, a steam accumulator, six steam headers with different pressure levels, several pressure reducing valves as well as the electrical power system were modelled. A control strategy for keeping the pressures in the six different steam nets was developed and tested in various simulation scenarios in grid operation as well as island operation. Switching from grid operation to island operation was included among the scenarios. The control system was also tuned before commissioning.

## Results

The task to design the control strategy and tune the control system of the new complex steam net required extensive simulations to meet the steam consumers high requirements on steam conditions for the various scenarios. The commissioning tests revealed that the resulting control design and tuning was well-functioning, and the startup was smooth and efficient.

Simulation of board machine stop and restart in island operation:

- At about 800 seconds in Figure-3, a board machine stops and gives a large instant steam load drop.
- The bark boiler slowly reduces, and the steam accumulator is charged, while the recovery boiler is affected only by the electrical motor starts.
- As seen in the second diagram the steam flow through the turbine is redistributed in a complex way during transients. The control system handles both the adaptions to the new steam load condition and the electrical interferences. The control strategy is designed to handle this trip with priority between different steam nets and with the aim to minimize losses in air blow.
- At about 2000 seconds the board machine is restarted, and the steam loads go back to normal. The bark boiler slowly increases, and the steam accumulator is discharged.

## Conclusions

Through dynamic modelling and simulations, the control system could be effectively designed before commissioning so that the startup could be fast and efficient. The resulting control strategy is robust and proven to work very well in practice during different transients. Turbine trip, which was the biggest fear, is very well handled by the control system and the pressures are stable and within acceptable limits.

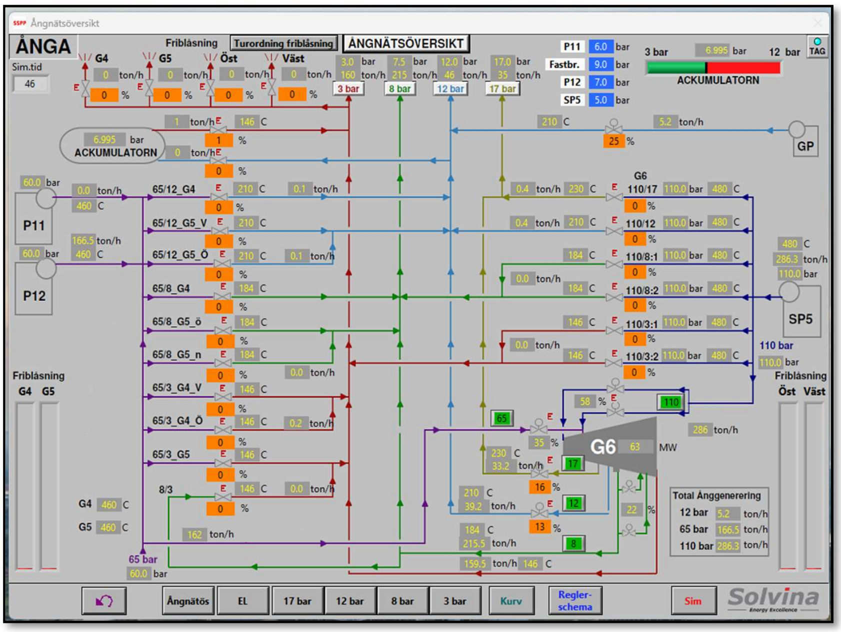


*Figure-2: Operator Training Simulator developed for Iggesund*

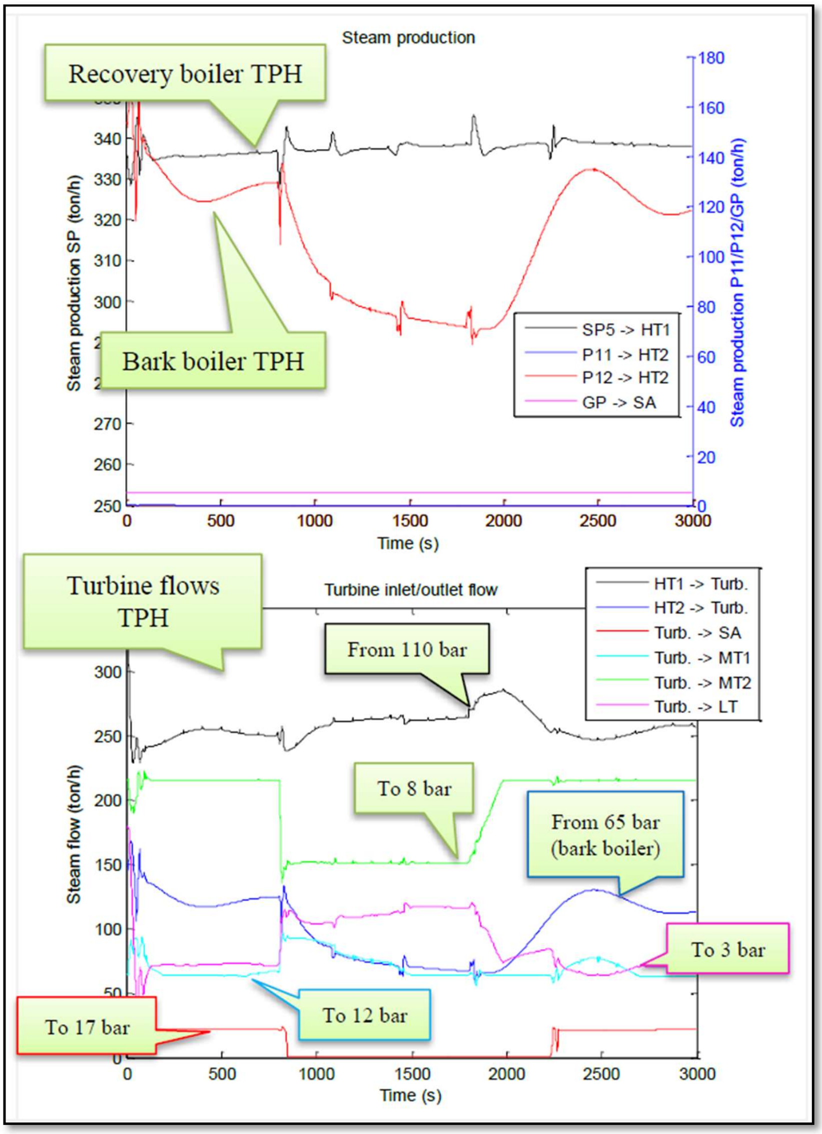


*Figure-3: Results from dynamic simulation study*