DYNAMIC SIMULATION ASSISTED POWER-PLANT ENGINEERING

CASE 1: NEW CFB BOILER AND CONDENSING TURBINE FOR A PAPER MILL
Mikael Maasalo, Senior Advisor, Power Plant Controls
Jarno Nyman, Advisor, Power Plant Controls
INTRODUCTION

- Industrial power plant in Europe, produces steam for paper mill
- A new CFB boiler, a condensing turbine and a back-up auxiliary boiler were installed and started in 2010
- Existing steam-net controls had to be combined together with the new steam-net controls

Previously part of the process steam was purchased from a nearby utility: steam pressure was controlled with the valve on the boundary. The new boiler delivers this part of the steam and the pressure will be controlled by the new condensing turbine.

The client wanted to check the new steam-net behaviour, especially during a condensing turbine trip
- challenging due to small turbine by-pass capacity
- risk of tripping the CFB → risk of tripping also paper machines in the worst case
DYNAMIC SIMULATION STUDY

A simulation study was carried out. The results indicated the following:

- During normal operation the new condensing turbine was able to control LP pressure during worst disturbances
- In order the power plant to survive a turbine trip, the turbine and condenser by-passes had to be fast-opened, and the start-up valve must be equipped with a fast pneumatic actuator
- Turbine control system needed modifications in order to function well with the existing power plant
- The new power-plant steam pressure controls had to be specified in order to tie them together with the existing ones

Some turbine trip simulation curves, without and with fast start-up valve actuators. Drum level drops considerably in the first case.

Partial Modysim™ model of the case mill
A fully functioning steam-net control configuration was developed during the dynamic simulations.

In order to implement the controls and achieve the simulated results, a specification for the control configuration was developed.

Specification was given to automation and turbine suppliers as the basis for their control system design and programming work.

Pöyry supervised the configuration and participated in the steam-net control FAT.

Training sessions for the mill personnel were carried out by Pöyry on site.

Pöyry steam-net personnel participated in the start-up, commissioning and finetuning the steam-net controllers.
SIMULATED VS. REAL-LIFE CURVES: PM WEB BREAK

Paper machine web break simulation results:

Paper machine web break, actual trend curves after finetuning:
SIMULATED VS. REAL-LIFE CURVES: TURBINE TRIP

Steam turbine trip simulation results:

Steam turbine trip, actual trend curves after finetuning
SUMMARY OF THE RESULTS

- The worst disturbances that can take place during the new power-plant operation were tested already in the beginning of the engineering
  - Process and automation engineering were supported during the entire power-plant design with the power-plant control requirements
  - The modifications that were required in the DCS and in the turbine control system were specified at an early stage instead of fixing them by trial and error during the commissioning
- The steam-net control system developed during the simulations worked perfectly from the very first moment allowing to reach a very good pressure stability (±0.05 bar during normal operation, ±0.1 bar during upsets) and an eased start-up
- Steam-net control commissioning was over in just few weeks instead of several months
- Back-pressure power generation of the turbines will be maximised during the operation, because the pressure will be maintained as stable and as low as possible under all circumstances.
CONTACT:
NAME: MIKAEL MAASALO
TITLE: SENIOR ADVISOR
MAIL: MIKAEL.MAASALO@POYRY.COM
PHONE: +44 7 528 786 482