OPTIMIZATION OF CONDENSATE EXTRACTION PUMPS’ FLOW CONTROL

On the majority of the Condensate Extraction Pumps installed in power stations, flow control is implemented by conventional valve throttling of the discharge valves of these pumps. This type of flow control is uneconomical as more than 30% of the flow and pressure is throttled or “wasted” under normal operating conditions.

Using Flownex® a case study was conducted on a 4100 MW coal-fired power station in order to compare different flow control techniques and gain an accurate representation of achievable savings.
CHALLENGE:

With increasing environmental awareness, higher electricity production costs and a shortage in electricity supply to the South African grid, increased focus has been placed on the energy efficiency of power plants and the improvement thereof.

On the majority of the Condensate Extraction Pumps installed in power stations, flow control is implemented by conventional valve throttling of the discharge valves of these pumps. This type of flow control is uneconomical as more than 30% of the flow and pressure is throttled or “wasted” under normal operating conditions.

A Flownex® model based on the existing condensate system at a 4100 MW coal-fired power station was used to explore different pump flow control techniques to decide on an appropriate retrofit option.

The challenge was to compare the input pump power consumed when retrofitting a conventional mechanical control valve with an electrical variable speed drive (VSD) control.

BENEFITS:

The benefits using Flownex® for this system were:

- Multiple investigation studies into different retrofit options could be performed without affecting plant operations.
- Built in Flownex® tools could be used to model a useful and interactive system.
- A more accurate representation of actual savings potential was provided.

SOLUTION:

The results from the model provided a better understanding of the pump duty and pump performance and these results could be compared to mathematical calculations and actual testing. This provided a more accurate representation of the achievable savings.
INTRODUCTION

On the majority of the Condensate Extraction Pumps installed in power stations, flow control is implemented by conventional valve throttling of the discharge valves of these pumps. This type of flow control is uneconomical as more than 30% of the flow and pressure is throttled or “wasted” under normal operating conditions.

Variable speed drives (VSDs) can achieve reduced flow by providing adjustable pump speed operation. This results in reduced system pressure and operation near the pump’s Best Efficiency Point (BEP). In addition, maintenance costs might be reduced.

The challenge was to compare the input pump power consumed when retrofitting a conventional mechanical control valve with an electrical VSD control.

SYSTEM DESCRIPTION

The system comprises of two condensate extraction pumps (CEP) pumping from the condenser through three low pressure feed

“A fully transient simulation was carried out.”
water heaters to a deaerator. Currently flow is controlled with the use of a condensate control valve. A recirculation valve also ensures that the pump’s minimum flow requirements are met during low loads and start-up.

OBJECTIVE OF SIMULATION

The objective of the simulation was to compare the input pump power consumed when retrofitting conventional mechanical control with electrical variable speed drive (VSD) control, and to determine the potential savings.

FLOWNEX® MODEL

Models of the power plant condensate system with both a conventional fixed speed pump and a variable speed drive controlled pump were modelled in Flownex®. Many existing tools and capabilities of Flownex® could be utilized in order to model a useful and interactive system, such as an interactive HMI, results and input visualizations and integration with Excel®.

DESCRIPTION OF SIMULATION

A fully transient simulation was carried out.

"The immediate effect of the variation in unit load could be displayed in terms of condensate extraction pump power."
Track bars were used in order to vary the unit load [%] on the system. The immediate effect of the variation in unit load could be displayed in terms of condensate extraction pump power saving [kW] on the same canvas.

RESULTS

Calculations indicated a saving of 34.5% (320 kW) in input pump power consumed when retrofitting conventional mechanical control with electrical VSD control. The variability of the load on the power station units increased this saving to 52.4% (455 kW) as the pumps would be utilized at lower average flow rates. However, actual performance tests on these pumps uncovered inefficiencies that reduced the savings potential to 39.1% (362 kW). Return on investment for the retrofitting of a throttling valve with a variable speed drive will potentially be 1.5 years.

CONCLUSION

Flownex® was used to simulate a complex condensate extraction pump system with the aim of investigating different pump flow control techniques.

Flownex® proved to be a valuable tool in determining the achievable savings and providing a better understanding of the pump duty and pump performance.

Figure 3: Flownex® view of LP feed heating system.