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CASE STUDY

Steam System Control Valve Replacement & Automation

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Case Study: Steam System Control Valve Replacement & Automation

CUSTOMER

Weyerhaeuser Company is an American timberland company which owns nearly 12,400,000 acres of timberlands in the U.S. and manages an additional 14,000,000 acres of timberlands under long-term licenses in Canada.

BACKGROUND

Steam Management Inc. (SMI) was engaged by Weyerhaeuser to design and install a control valve replacement, automation, and steam metering project at their veneer mill in Zwolle, LA.

Project objectives:

- Provide a means to monitor steam flows & pressures at the various process users and display this data in the boiler room to enable better system management.
- Replace pneumatically actuated steam control valves with electrically actuated control valves.

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INITIAL CONDITIONS

The site operates a 1974 Zurn biomass boiler, utilizing the majority of the 280psig steam produced for block (log) heating, veneer drying, & sheet pressing. The boiler fires process waste (mostly southern yellow pine bark) produced on site. Due to limitations from the mechanical separator and overfire air fans, the boiler is limited to an output below its nameplate rating. During some plant operating scenarios, particularly in winter conditions, the steam supply was significantly strained.

Because of these supply constraints, steam data feedback and tighter flow control were desired to optimize the plant's steam usage. This project was intended to enable better control of the system, thus conserving available steam for the required process use.

The site's instrument air (IA) dryers are old and no longer capable of maintaining a reliable dew point, resulting in the IA line freezing during winter conditions. For this reason, electrically actuated valves were requested to avoid valve malfunctions and production interruptions.

STEAM VATS

The site utilizes eight steam chests (vats) for block heating to optimize the logs for the lathe/peeling process. Each vat is supplied with a mixture of low-pressure steam, condensate, and boiler blowdown to directly heat the blocks for an extended period. One pneumatic, 3in 150# flanged control valve at each vat was used to control this flow. The heating medium is contaminated in this process and the condensate is sent to drain.

A steam header rerouting project was planned for the supply line to the vats when this project began.

VENEER DRYERS

The mill utilizes steam in two veneer dryers. Each dryer operates in temperature controlled, staged chambers. The first chambers do the bulk of the drying and are fired by natural gas. The subsequent chambers are heated with full pressure steam. Two steam control valves are used per dryer, which were initially 2.5in pneumatic 300# flanged steel valves.

PRESSES

The mill utilizes two veneer presses which are heated with steam. Each press is supplied with one 1in 300# flanged pneumatically actuated steam control valve.

KEY ACTIONS

The limited availability of plant-wide steam outages and the long lead-time of critical components complicated this design/build effort. To facilitate both limitations, the design effort included accelerating the material selection process ahead of the 100% design, with customer buy-in, to ensure materials would be available and on-site for the January outage.

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PROJECT SCOPE

EQUIPMENT

SMI replaced the existing pneumatic control valves with electrically actuated valves including position indication feedback and internal actuator heaters. Precise process requirements were not available for each valve location, so the new valves were sized to match or exceed existing control valve Cv values to avoid further constraint of steam flows. In the case of the dryers and presses, this required an increase in the size of the valves from 2 1/2in to 3in, and a 1in to 1 1/2in, respectively.

Standard ISA dimensioned valves were selected at all locations, and piping was modified to accommodate these new dimensions. Since these valves have a standard face to face dimension, any future replacements will be easily performed, even with alternate manufacturers' valves.

To measure the required values for flow estimation at the dryers and presses, SMI installed upstream and downstream pressure transmitters at each of these steam control valves, (6 valves, 12 total transmitters).

A before and after of a dryer steam control valve station is shown below:

Figure 1 – Original Dryer Steam Control Valve

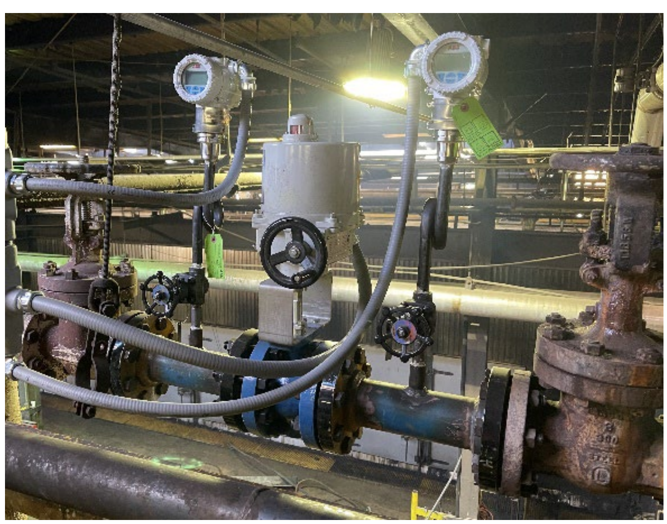

Figure 2 - New Dryer Steam Control Valve & Pressure Transmitters

KEY OUTCOMES

1. Boiler operator control of steam flow:

• Provided a high level of steam flow visibility for all major process steam users in the plant

• Added functionality to measure process data that could be monitored and trended over time for system analysis

2. Improved system performance:

• Adjusted valve ramp rates to prevent control overshoots

• Added control overrides at each valve for steam header pressure protection

• Replaced the existing pneumatic valves with electrically actuated valves with internal actuator heaters, providing better freeze protection for the system.

• Added a flow limitation at the steam vats to prevent overstressing the boiler and reduce steam losses.

SMI did not recommend the same method of flow indication for the steam vat control valves due to the mixed phase nature of the heating medium steam/condensate/boiler blowdown). Instead, SMI advised at 30% design that a flow transmitter be included in the steam header upgrade project (performed by others). That project was completed before this installation.

Valve power, valve position, transmitters feedback and transmitter power wiring were all new circuits that had to be routed within new conduit and terminated at the valves and appropriate I/O points.

CONTROLS ENGINEERING & PROGRAMMING

The project included PLC programming to calculate steam flows across the dryer and press steam valves. The program uses saturated steam properties, based on the readout of the valve's upstream pressure transmitter. The program then calculates flow across each valve based on the valve's position vs. Cv flow curve and the differential pressure reading across the valve, measured between the two transmitters.

For the vat valves' flow estimate, the new flowmeter value is proportioned across the valves based on each valve's position feedback.

During the project's design, extra functionality was added to the programming to override valve position based on an upstream pressure setpoint at each valve. This function serves to protect the steam header pressure from being depleted. If the steam pressure drops too far, the valve enters "holdback"
mode, and the PLC limits the valve until header pressure is restored. This pressure set point can be set strategically for each location to prioritize users (i.e., if dryer 1 is the priority over the presses, dryer one pressure protection set point could be set lower so that holdback mode for that piece of equipment
activates later).

Additionally, a "flow holdback" mode was programmed for the vat valves to limit the total flow to the vats.

The following controls engineering deliverables were provided for the project:

• Network diagram showing design concept and controls scope
• I/O list with 40 data points, including 26 new feedback signals, terminated in 3 separate PLCs
• Functional Design Specification (FDS) and Detailed Design Specification (DDS) documents
• System testing plan
• Factory Acceptance Test (FAT) performed using an in-house created process data simulator

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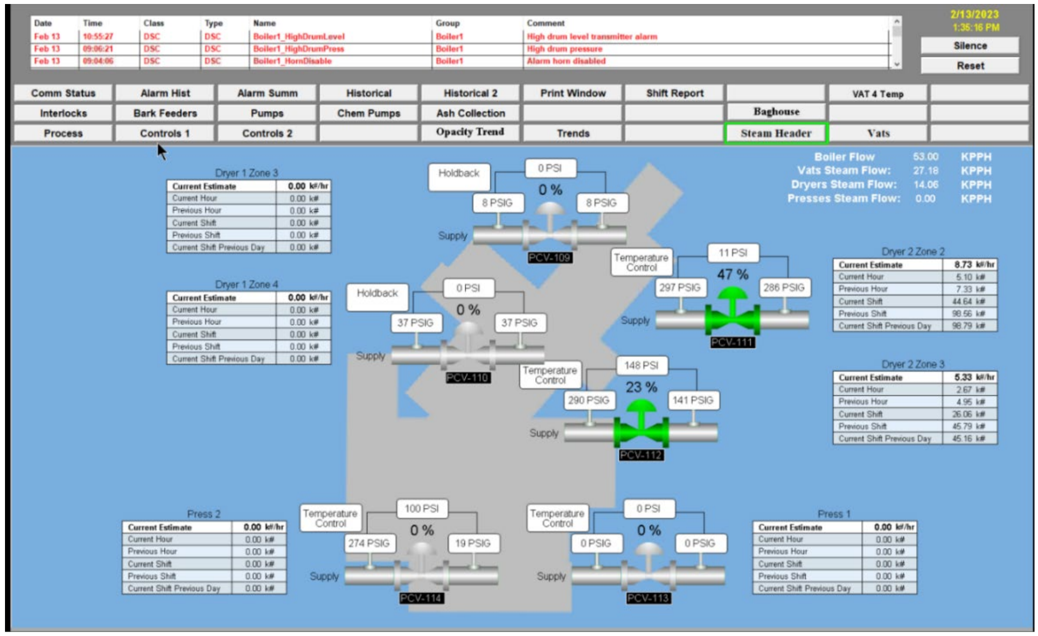
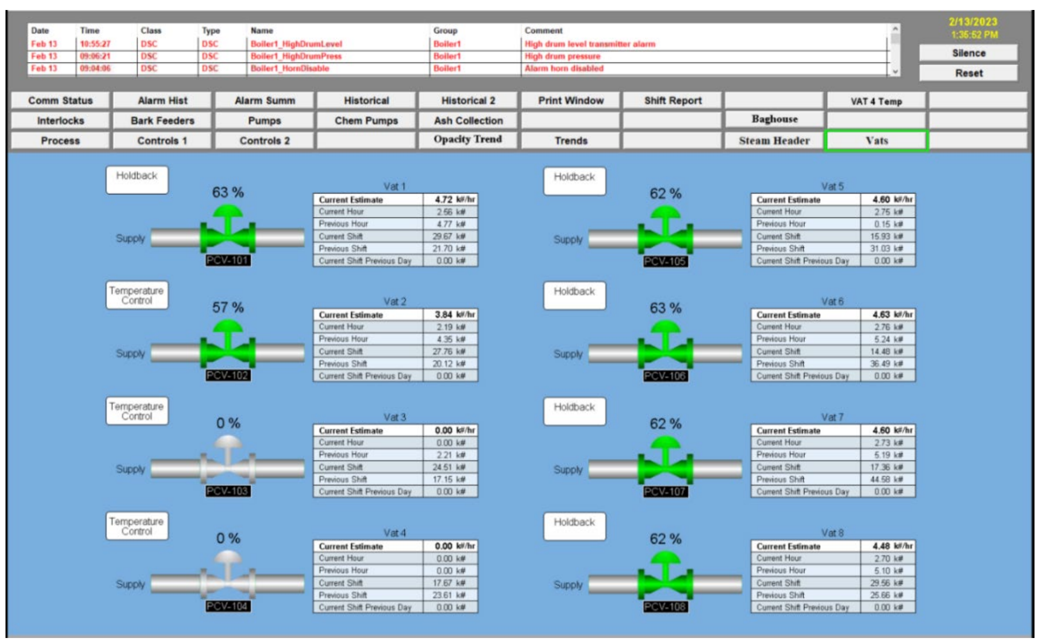
KEY OUTCOMES

3. Operational Efficiency

- These new functions provide better control and protection of the system, reducing the site's fuel usage and providing a more reliable steam supply for the mill's process equipment.

- PLC program modifications, uploads, and troubleshooting to incorporate all new features and calculations for 4 separate PLCs.
- Coordination of all new data points and collaboration with Weyerhaeuser controls engineers on new HMI screens to communicate the new data. These screens are shown below.





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