B4022

FCV01D

PID

PID

Boiler

TIT01

Saturation Rate Limiter

Saturation Rate Limiter

FCV02D

(P1)

F()

FT02

Function

F()

P1-Temperature Control (TC)

Rate Limiter Function

FIGURE 7. TEMPERATURE CONTROL OF THE BOILER.

P1-CC: Cooling Control

P1-CC drives frequency (PP04) of the cooling water pump. This activates the pump operation at the set point (PP04SP) when the water temperature (TIT03) in the main water tank is in the operation range.

PP04

PP04SP

Boiler

TIT03

(P1)

Saturation

P1-Cooling Control (CC)

Activation

FIGURE 8. COOLING CONTROL OF THE BOILER

BOILER CONTROL LOGICS

The HAIEnd dataset covered control loop of Emerson Ovation DCS in detail. For the sake of better understanding, we additionally provide the detailed control logic of boiler process.

P1-PC Control Logics

P1-PC is a feedback control loop for two pressure-control valves (PCV01D and PCV02D) and maintain the pressure (PIT01) between the main and return water tanks according to an operator's setpoint command (B2016). HAI dataset included only I/O of control process.

In fact, the control loop is not a single logic but a collection of multiple algorithm blocks that perform different functions, such as a fast Boolean, flip-flop, and PID. For example, the I/O and internal points can be represented simultaneously by expressing algorithm functions as individual nodes in the control logic as shown in Figure 9. The control logic with I/O and internal points as nodes takes the form of a bidirectional graph. Each point name is marked on the edge. HAIEnd dataset contains all the named edges on the graph, as well as some point not connected to the control logic for maintenance. For more information, please refer to graph configuration files included in HAIEnd dataset.

HAIEnd dataset included both I/O (PCV01D, PCV02D, PIT01, B2016, PP01A, PP01B) and internal point as represented by the edge in control logic. Internal point is used to deliver processed value to each algorithm blocks.