AFT Fathom™ Validates Power Plant System Conversion

CASE STUDY

Circulating Water System

Power Generation Industry

Sargent & Lundy LLC
Chicago, Illinois, USA
Platinum Pipe Award Honorable Mention - Software Features and Model Creativity

Sargent & Lundy was tasked with modeling a circulating water system for an undisclosed four-unit power plant located in the eastern U.S.

The project involved converting an existing open-loop circuit—where water is taken from and discharged to a local river—to a closed-loop system where the water is instead routed to a new cooling tower (see Figure 1). This system provides cooling water to the plant condensers to reject heat and to condense the exhaust of the steam turbines.

The plant modification presented many challenges because it integrated new and old equipment. The existing circulating water pumps, intake basin, piping and concrete tunnels were reused. The new equipment included a cooling tower pump basin, four cooling tower pumps, a 16-cell cooling tower and the cooling tower basin. New piping was also added between the cooling tower pump basin and the cooling tower, as well as between the cooling tower basin and the existing intake basin.

> "The simulation…confirmed that the overflow lines would…prevent the cooling tower basin from overflowing. This would have been massively difficult to determine with hand calculations or less capable software."

Matt Thomas, senior engineer at Sargent & Lundy, used AFT Fathom and the Extended Time Simulation (XTS) module to model the system conversion.

In addition to the XTS module, several software features were used to model potential complications with the addition of the new equipment. These features included: finite open tanks with both constant and variable cross-section, variable speed pumps, a transient event triggered by time and a transient event triggered by pressure.

All of the scenarios were run using the XTS module to model the long term transient effects on liquid heights in the cooling towers and to see how the non-tripping pumps would react over time to changes in static head.

Finite open tanks were used to model both the existing and new water basins, allowing Thomas to determine the basin water levels under both steady-state conditions and transient events such as pump trips and plant shutdowns.

"The software allowed us to determine if and when the basins would overflow or empty during a pump trip scenario," Thomas said.

Thomas made use of the variable speed capability of the pump junction to simulate the flow rate from the new variable speed pumps into the pump basin. He also used the pump junction's transient capability to model a pump trip from steady-state conditions, reducing the pump flow rate to zero over a short time and simulating a trip.

Lastly, AFT Fathom's valve junction transient capability was used to simulate an open pipe filling up with water and acting as an overflow line. This simulation assisted in selecting the required pipe size and elevations as well as confirmed that the overflow lines would operate properly and prevent the cooling tower pump basin from overflowing.

"This would have been massively difficult to determine with hand calculations or less capable software, if for no other reason than it would have been difficult to account for the change in pump flow rate as the source and basin water levels changed, which changes the operating pump head," said Thomas.

For 125 years, Sargent & Lundy has remained exclusively focused on the power industry, providing leadership and quality services for complex power generation and transmission projects. Their technical specialists are industry leaders in code committees and all aspects of leading-edge technical issues with a full range of services available globally in more than 90 countries.

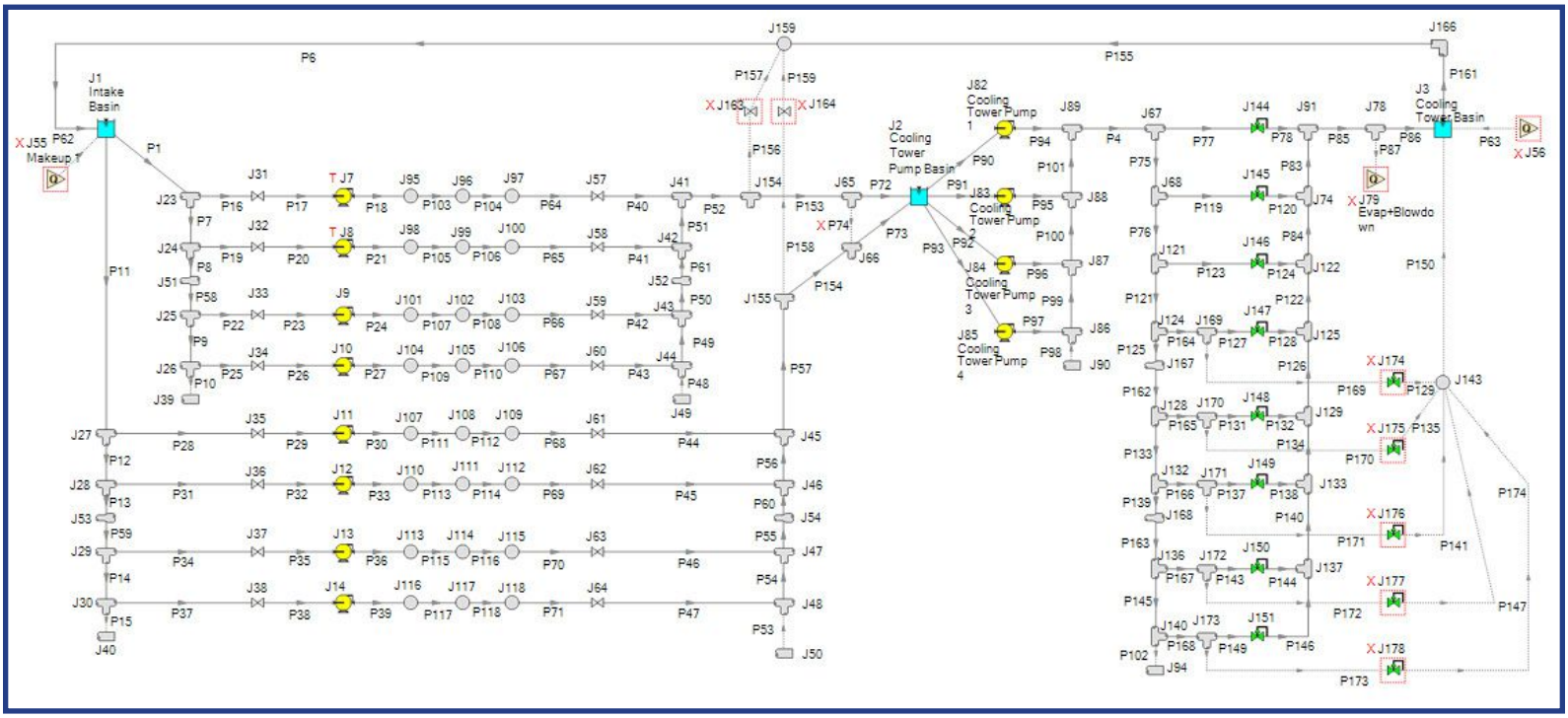

Figure 1 - AFT Fathom model of a closed-loop system where water is routed to a new cooling tower

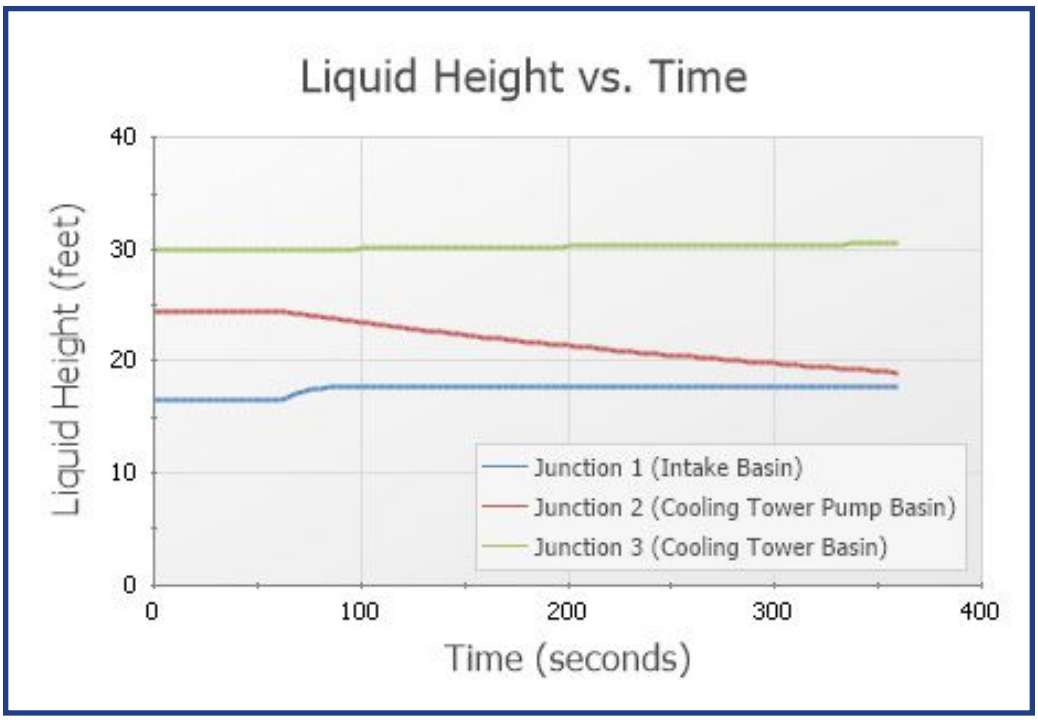

Figure 2 - Liquid Height vs. Time for the main basins of the power plant's circulating water system as predicted by the XTS module