Digester Complex Heat Reservoir Recirculation System Hydraulic and Thermal Analysis Accomplished with AFT Fathom™

CASE STUDY

Water Reclamation System
Water & Wastewater Industry

Brown and Caldwell
Phoenix, Arizona USA
Platinum Pipe Award Honorable Mention - Use of software features and model creativity

Tyler Knight of Brown and Caldwell was tasked with developing a system curve and pump design points for heat reservoir recirculation supply and return (HRS/HRR) loop pumps. The goal was to determine if existing heat reservoir recirculation pumps could deliver minimum 340 gpm / 1,300 liter/m to the heat reservoir loop to maintain the loop's temperature.

This required not only a hydraulic calculation but also a coupled heat transfer analysis of the system. Knight included convective heat transfer on pipes to ambient.

> "I modeled a boiler loop and several secondary heat exchanger loops to simulate the heat loads gained and loss by the system. Fathom was able to do this simultaneously which is much more efficient than typical Excel calculations."

This was the third phase of a water reclamation plant project and Knight's team inherited old Excel calculations from when the system was built in 2004 that were difficult to follow, tedious, and prone to mistakes.

The team set out to re-model the system with both current reliability and future expandability in mind. With the next phase of the expansion scheduled to begin a few years out, Knight wanted to ensure the next engineer could easily understand and make modifications to calculate any new system parameters.

The existing system used heat reservoir recirculation pumps (PMP-13-021, 022, 023) to circulate hot water from the Boiler Building to the Digester Complex. At the Digester Complex, the hot water from the system is circulated through four different digester heat exchangers to heat the digester sludge. The goal was to have two heat reservoir recirculation pumps and two boilers in operation with one standby of each. The heat reservoir loop was sized using the peak heating demand and then modeled using AFT Fathom, Figure 1. All the equipment data and pressure/heat loss information was able to be input into AFT Fathom for pumps, piping, fittings, insulation, heat exchangers, etc...

The outputs from the AFT Fathom model aligned closely with actual conditions.

AFT Fathom was able to simultaneously model a boiler loop and several secondary heat exchanger loops to simulate the heat loads gained and loss, which was much more efficient than typical Excel calculations. The model assumed worst case scenario (maximum heat and pressure losses) to verify heat reservoir system can meet peak demand.

Important design parameters were verified and determined by the output from the AFT Fathom model including the minimum boiler return temperature and the approximate open percentage for the triple duty check valve on boiler circulation pumps.

Since a portion of the model had already been in service, Knight was able to validate the model by comparing the results to the existing operation conditions which gave the team confidence in using the model and allowed them to quickly move forward with the design.

***** AFT note to readers *****

This AFT Fathom case study is part of a 2-model case study by Tyler Knight of Brown and Caldwell. The additional study uses AFT Arrow where Tyler created a model to claim digester gas from the digester units and transport that gas back around to fuel the boiler units as shown in this AFT Fathom model.

While the two models work independently of each other, it is a great reflection of how companies around the world utilize multiple AFT products to reach end goals.

"(Identifying these set points and pump capacities) was not something we couldn't have done. It's more of how efficiently we did it. We solved 3 or 4 tedious calculations all within the single model," said Knight, "Ultimately it saved us time now and in the future when we expand on the project since we used AFT Fathom to create tie-in points and left space in the model to conveniently expand. Additionally, using the scenarios we were able to model seasonal changes in the system without having to re-do any calculations."

Brown and Caldwell is the largest engineering and construction firm solely focused on the U.S. water and environmental sectors. Creative designs and progressive solutions have helped municipal, federal and private organizations overcome their most complex environmental challenges. They offer a comprehensive range of engineering, scientific, consulting and construction services.

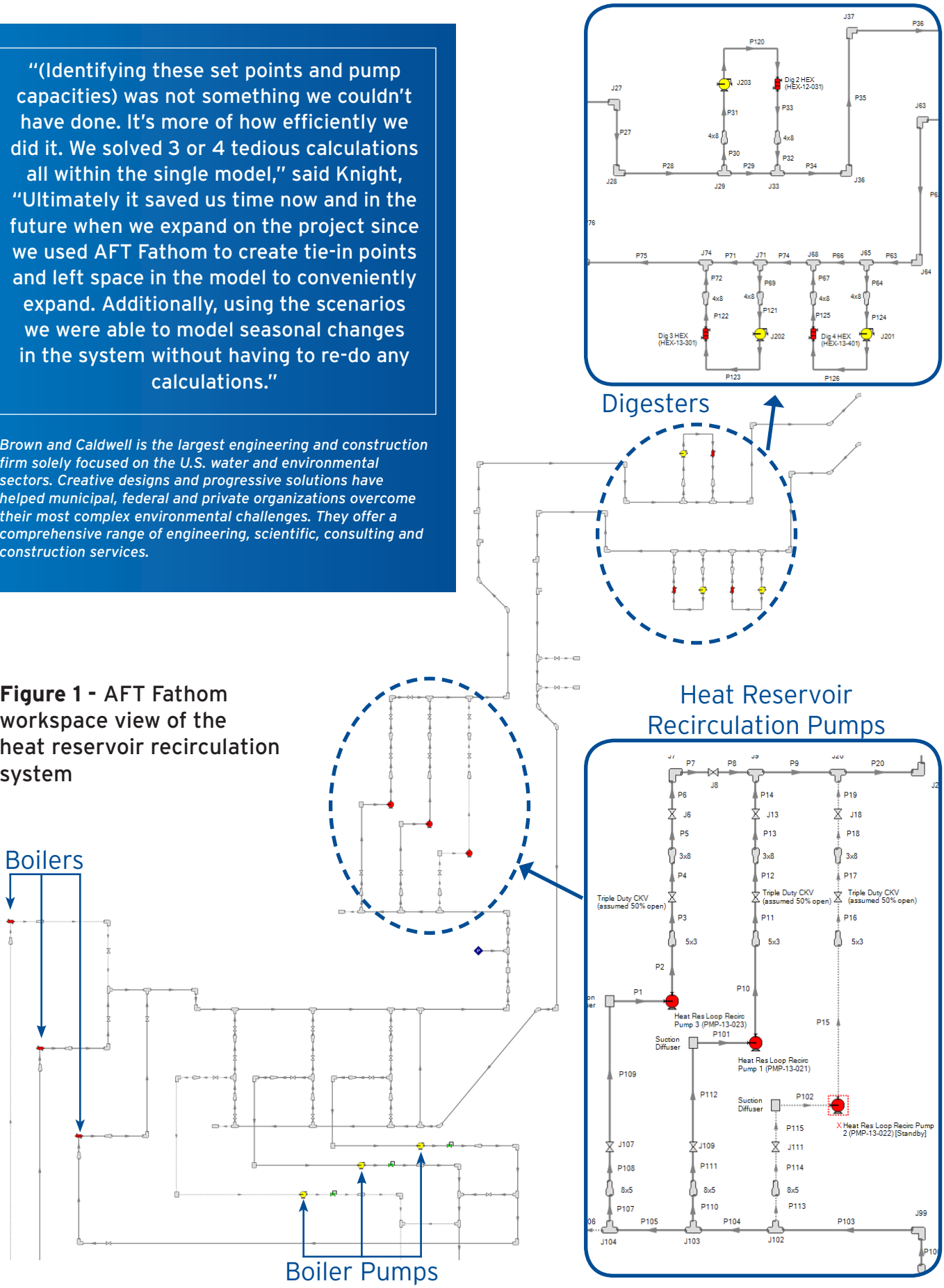

Figure 1 - AFT Fathom workspace view of the heat reservoir recirculation system