AFT FATHOM™ CASE STUDY

AFT Fathom used to Model Central Heating Cycle of a State-of-the-art Combined Heat and Power Plant

Power Generation

Applied Flow Technology

PROBLEM

Kerem Algüzey, design engineer at ENKA Insaat ve Sanayi A.S., used AFT Fathom to simulate the central heating cycle to inform the design of the hydraulic thermal system for the Dradenau Combined Heat and Power Plant under construction in Hamburg, Germany.

This state-of-the-art facility will produce 180 MW of electrical capacity and an additional 260 MW of district heating utilizing multiple heat sources including waste heat from industrial processes and a natural gas power plant. AFT Fathom was used to size pumps, heat exchangers, and control valves, and to validate line sizing to ensure that piping was within design requirements for the system.

SOLUTION

The system has several duty cycles including heat storage and heat extraction cycles. The Scenario Manager in AFT Fathom was used to model these cycles and the heat storage cycle was modeled with and without the heating condenser. Other modes that were modeled were summer operation, steady-state heating with different combinations of industrial heat supply, and heating condenser supply (including high pressure condensation). Steam turbine trips were simulated for each operating mode. Minimum flow, maximum flow, and pump trip scenarios for various pumps were also modeled.

Design Alerts were used to ensure that all pipes had flows below maximum mass flow and velocity limits, limits which varied for pipes of different sizes in different areas of the system. AFT Fathom results validated pipe sizing choices and allowed pumps, control valves, and heat exchangers to be sized appropriately.

AFT Fathom provided the best solutions in terms of both heat transfer and pressure loss calculations.

- Kerem Algüzey, ENKA

ANALYSIS

The plant utilizes waste heat by means of heat pumps from local industrial processes including three manufacturing plants, a dam, a waste incinerator, and a sewage treatment plant. Within the heat cycle, the industrial heat recovery consists of three pumps and six heat exchangers. Water returned from these sources collects additional heat by condensing steam generated from the facility's gas turbine, a crucial step for the turbine's power cycle (Figure 1).

Downstream of the heat extraction subsystem, a secondary water system transfers heat from the thermal cycle into the municipal district heating network of Hamburger Energiewerke using three pumps and five heat exchangers (Figure 2). In the summer or when excessive heat is available, water can instead be diverted to an air-cooling system to dissipate heat.

The heat storage system consists of a 50,000 m^3 (13,200,000 gallons) tank which provides additional pressure to the heat extraction pumps to prevent cavitation and can be used to pressurize the district heating system or supply it with a portion of its hot water directly as an emergency heat supply. Heat from the cycle is also supplied to auxiliary systems including a natural gas preheater, on-site heating, and anti-icing heat exchangers.

System: Hamburg, Germany

ENKA

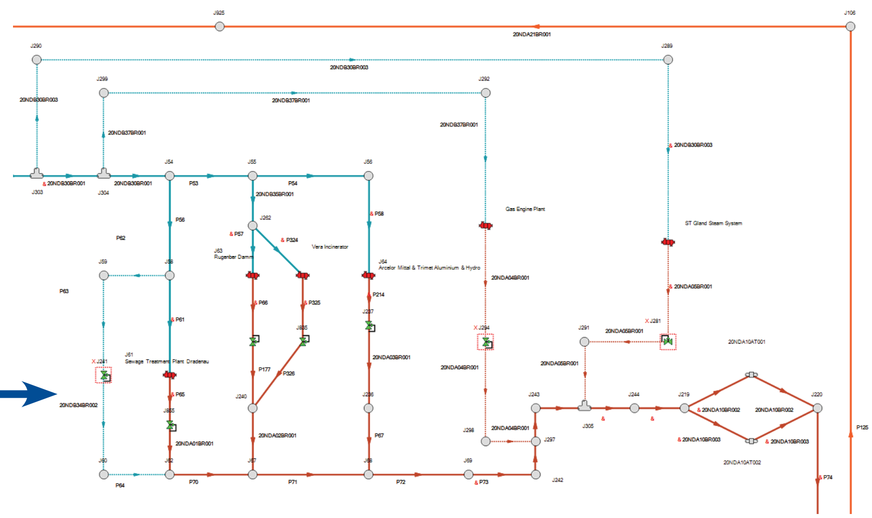
Platinum Pipe Award Winner: Most Interesting Model

ELEMENTS OF SUCCESS

The complexity of the system, the benefits of the project, and the excellent use of scenarios to analyze a range of operating conditions with various waste heat conditions and heat demands earned Algüzey the Platinum Pipe Award for Most Interesting Model.

FIGURE 1

A zoomed Workspace view of the heat extraction portion of the plant, where waste heat from industrial suppliers and heat from the plant's steam power cycle are captured.



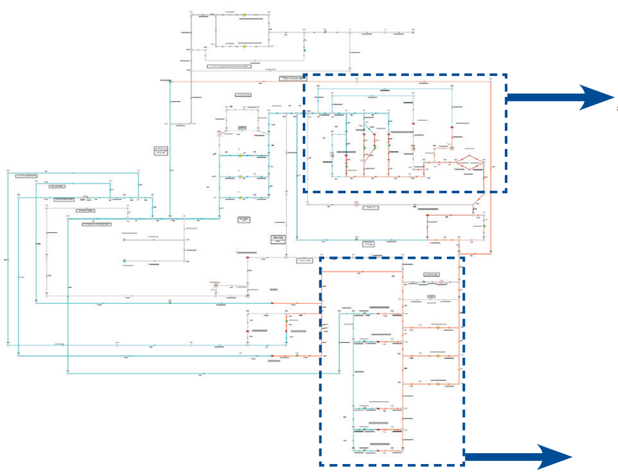


FIGURE 2

The secondary water system in which a group of five heat exchangers transfers heat into the district heating system.