Austin Energy: Pumping System Improvement Project Saves Energy and Improves Performance at a Power Plant

Benefits

- Saves $1.2 million annually
- Reduces annual energy consumption by 220,000 MMBtu
- Reduces maintenance costs
- Achieves 11-month simple payback

Applications

Circulating water pumping systems are needed for any application in which cooling water is required to maintain the temperature of a process. In this application, a power plant uses cooling water to condense steam.

Project Summary

In March 2004, Austin Energy—the electric utility for the city of Austin, Texas—completed an improvement project on the circulating water pumping system that serves a 405-MW steam turbine at its Decker Creek Generating Station. First, a pumping system assessment was performed in part by a U.S. Department of Energy (DOE) Qualified Pumping System Assessment Tool (PSAT) Specialist from Flowserve Corporation; this assessment helped utility personnel create a project that would improve the system's energy efficiency and output capacity. It involved upgrading several of the pumps' critical components as well as reconfiguring some equipment. When it was completed, the project greatly improved the pumping system's efficiency and performance. These improvements resulted in significant energy savings and reduced maintenance requirements.

Plant/Project Background

The Decker Creek Generating Station has two steam turbines and 200 MW of gas turbine peaking units. This project focused on the largest steam turbine, a 405-MW power plant that has been serving the city of Austin, Texas, since 1978. Two 1000-horsepower (hp) circulating water pumps deliver cooling water from a lake to equipment that condenses the steam coming from the turbine. Before the project, these pumps were unable to deliver the amount of cooling water required despite operating at full load.

Both pumps were designed to have a combined flow rate of 236,000 gallons per minute (gpm), which was supposed to achieve a turbine back pressure (TBP) of no more than 3.5 inches. During routine, twice-yearly heat rate testing, plant personnel found that the cooling water flow was insufficient to achieve the rated steam flow, and the power plant's efficiency was more than 5% below the design efficiency level. The assessment revealed that the system's actual flow rate when both pumps were running had degraded to 195,000 gpm, that pump efficiencies were between 50% and 55%, and that the TBP at times increased to as high as 4.1 inches of mercury absolute (HgA), or more than 17.5% above the design TBP. Furthermore, the pumps were vibrating severely, sump vortexes were frequent, and impeller surfaces were severely eroded.

The project involved upgrading the circulating water pumps with new impellers, diffusers, shrouds, and shafts. In addition, the plant personnel and Flowserve's pump repair shop reconfigured the suction bell, sections of the intake sump of both pumps, and the pumping station. Finally, they replaced the suction flow splitter below the pumps to better direct the incoming lake water.

Results

These improvements to the plant's circulating water-pumping system resulted in an increase in the pumps' combined flow rate to 11.5% above their design rating. This increase sharply reduced the need to operate both pumps concurrently to satisfy the plant's cooling water demand. Because of the reduction in the parasitic pump load and in the need for additional cooling water, the plant's efficiency increased, yielding annual energy savings of 220,000 MMBtu and energy and maintenance cost savings of $1.2 million per year. With total project costs of $1.1 million, the project had a simple payback of 11 months.

Lessons Learned

Circulating water-pumping systems should be checked periodically to ensure that they are operating satisfactorily. At the Decker Creek Generating Station, a kink at the low spot in the impulse line from the condenser to the vacuum manometer in the control room caused a water leg (trap), which prevented the vacuum manometer from providing accurate TBP readings. This, in turn, masked the performance of the system. Once the entire system was reviewed, including the pumps' efficiencies, plant personnel were able to discover the suboptimal flow rate of the pumps, determine its cause, and devise an appropriate improvement strategy.

After the project, tests showed that pump efficiency levels had risen to 85%. More importantly, the pumping system flow rate improved significantly. The pumps can now deliver more than 263,000 gpm, an 11.5% increase above the original design flow rate. There has also been a large reduction in vibrational amplitudes, from as high as 3.3 mils down to 0.2 mils, and a TBP improvement of about 3.2 inches HgA. These improvements allow the plant to operate at full capacity using only a single pump, and to do so much later into the summer than it did before the project began—saving both energy and money. The methods applied in this project can be implemented in power plants and at practically all industrial facilities that require water for process cooling.

Alan Flory

Partner Profile

Alan Flory is a mechanical engineer and a PSAT Qualified Specialist who has been with Flowserve for 12 years. He has worked with Flowserve's IT group to develop pump selection software and has authored technical papers on boiler feed water pumps. In his current role as Industry Director, he focuses on upgrading the efficiency and reliability of pumping systems for Flowserve's industrial customers.

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Project Partners

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Austin, TX

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Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, DC 20585-0121

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