OMNI Condenser Performance program helps power plant reduce fuel costs, reduce environmental impact and increase condenser efficiency

OMNI™ Condenser Performance

NALCO Water
An Ecolab Company

CASE STUDY - POWER
CH-1272

BACKGROUND

Coal-fired plants operate in a highly competitive market. Electricity demand is growing slowly and is predicted to continue that trend for several years. Natural gas prices are low compared to coal. Labor costs in a coal plant are higher than those in most gas plants. Coal-fired plants must clear regulatory and environmental hurdles much higher than natural gas-fired plants. All of these challenges mean operators of coal-fired power plants need to be mindful of costs and look for any potential opportunities for efficiency gains.

SITUATION

This case study was documented at a 148 MW coal-fired power plant located in the eastern United States. The plant cycles frequently – an emerging trend in the coal-fired segment – and the plant operates at about 30% Capacity Factor.

Condenser performance is a key performance metric for a power plant. Cleaner condensers, operating at high efficiencies, reduce fuel usage and help the plant generate reliable, low-cost power when called upon. Over the past several years, Nalco Water has worked with power plants across North America to develop the OMNI Condenser Performance program, identifying and addressing condenser problems and quantifying the value of addressing them. A recent evaluation at the plant, and subsequent changes to their cooling water treatment program, resulted in fuel savings of over $100,000.

Diagnosing a condenser performance problem

Most power plants monitor Cleanliness Factor. It is a catch-all metric that aggregates many factors into one number...which is both its strength and its weakness. As can be seen in Figure 1, cleanliness factor had been declining over a four-month period. Condenser back pressure showed a similar, but opposite, trend over the same period, as did the condenser terminal temperature difference (TTD) — also referred to as approach temperature — which showed a TTD three times higher than design.

Condenser performance is a complex subject and looking at a few indicators

Customer Impact	eROI℠	Economic Results
Reduced greenhouse gas emissions by 3,680 metric tons	AIR	$100,000 per year operating costs

eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.

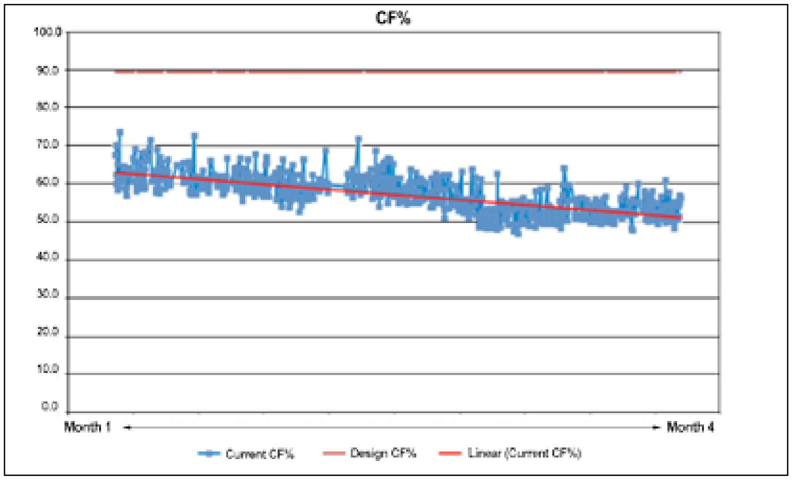

Figure 1 – *Cleanliness Factor decreased.*

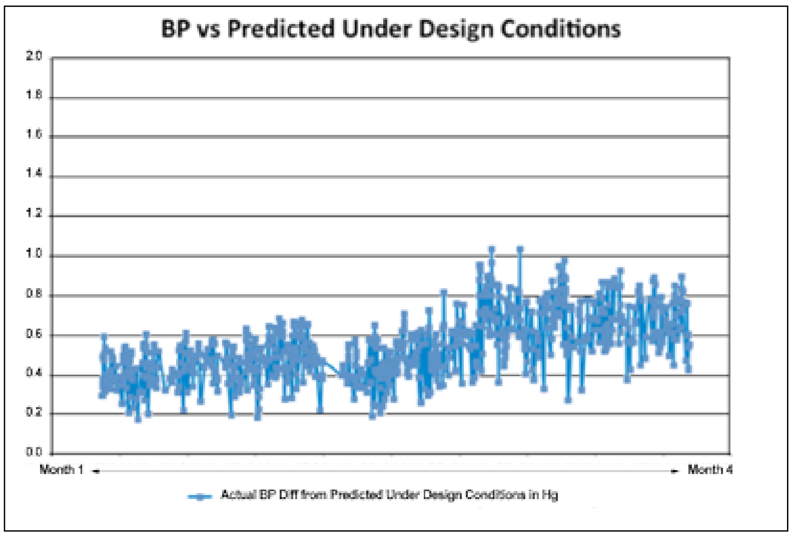

Figure 2 – *Condenser Backpressure increased.*

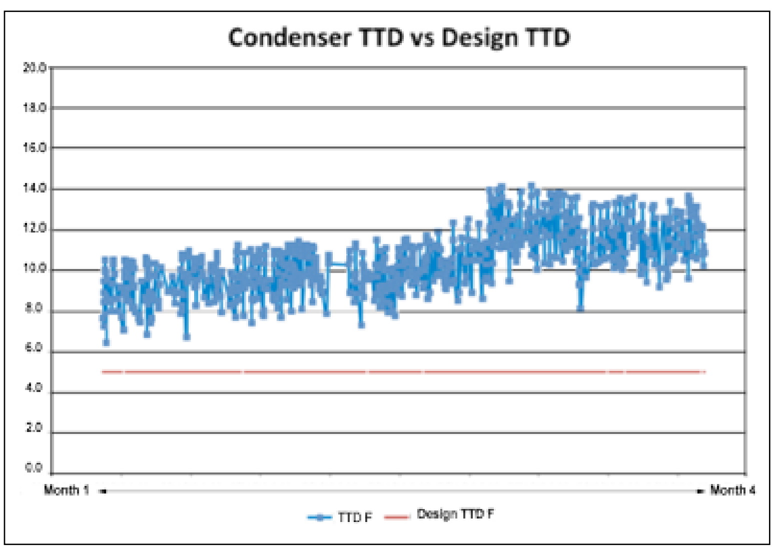

Figure 3 – *Condenser Approach Temperature -- or Terminal Temperature Difference (TTD) also rose during this period, leading to the initial diagnosis of a fouled condenser.*

rarely reveals the actual cause of performance degradation. For instance, one might look at increasing back pressure and identify macrofouling as the cause, but the temperature rise across the condenser did not change during this period, ruling out that possibility.

This plant tracked the weight of the cooling tower fill continuously online. OMNI revealed the cause of the condenser performance degradation: cooling tower fouling.

Power plants rarely have the luxury of flawless execution of industry Best Practices. The situation here was a case in point. In most cases, a power plant will chlorinate on a schedule to a set halogen residual or continuously chlorinate to a set ORP. Neither of these practices was possible at this plant because of the cyclical nature of their operation. They chlorinated when they could, as much as they could. The result: they never actually achieved good bio-control.

SOLUTION

During the summer of 2010, the plant had applied a bromine-based oxidizing biocide on a trial basis.[1] Shortly after application, the tower fill weight dropped, as did the back pressure – as shown in Figures 4 and 5 – but the program was discontinued because the cost was perceived as too high for the benefit derived.

Nalco Water Towerbrom™ is a fast-acting biocide and is highly effective against sessile microorganisms. A fouled system generally requires a high initial concentration of a bromine-based biocide, even in cases where the original program was performing. Often, users will combine Towerbrom with bleach to offset this effect, but the requirement to obtain and maintain a 0.8 to 1.2 ppm free residual oxidant remains. Once the system is brought into good microbial control, maintenance dosages can be as little as one tenth as high as the initial dosage.

Condenser performance concerns were nothing new to the engineers at this plant, but they had long assumed their problems were related to under-sized cooling towers. The decision to

[1] TowerBrom 960 was applied to achieve a 1 ppm residual.

discontinue the Towerbrom program was made before the OMNI Condenser Performance program was put in place. When all factors affecting condenser performance were taken into account, the implication was clear: the size of the cooling towers was not the problem. The root cause of the problem was microbial fouling in the cooling towers.

RESULTS

To justify a bio-control program, the plant needed to quantify the cost of continuing as they had.

The efficiency loss resulting from the microbial fouling was estimated at 250 BTU/kWh. The cost of the efficiency loss: $100,000/year. The cost of the chemical treatment program: $90,000 for the initial treatment and $9,000/year thereafter. The program paid for itself in the first year.

In the following years, when the only cost associated with the program was the on-going maintenance dosage, the plant realized a return of 1,011%, making the program pay for itself every year in a little more than one month.

Capacity Factor is the ratio of the actual output of a power plant over a period of time and its potential output if it had operated at full nameplate capacity the entire time. This plant's Capacity Factor is 30%. The overall thermal efficiency of the plant is about 35%. Based on these metrics and an estimated coal cost of $72.67/short ton, their annual fuel cost is about $1.3 million.[2]

$$\frac{Output\ (MWh)}{Hours\ \times Capacity\ (MW)} = Capacity\ Factor$$

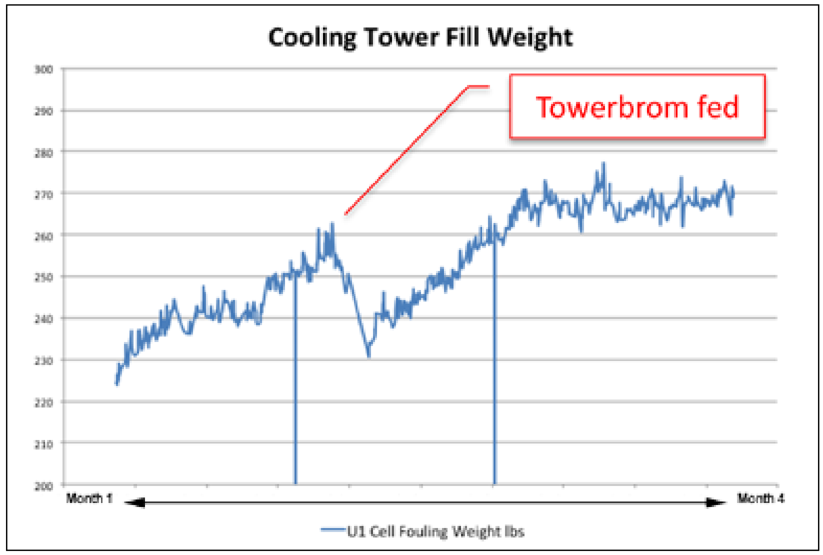

Figure 4 - *The actual cause of the problem was microbial fouling in the cooling tower. When the deposits were removed, the weight of the cooling tower fill dropped. When the biodispersant program was discontinued, the weight increased again.*

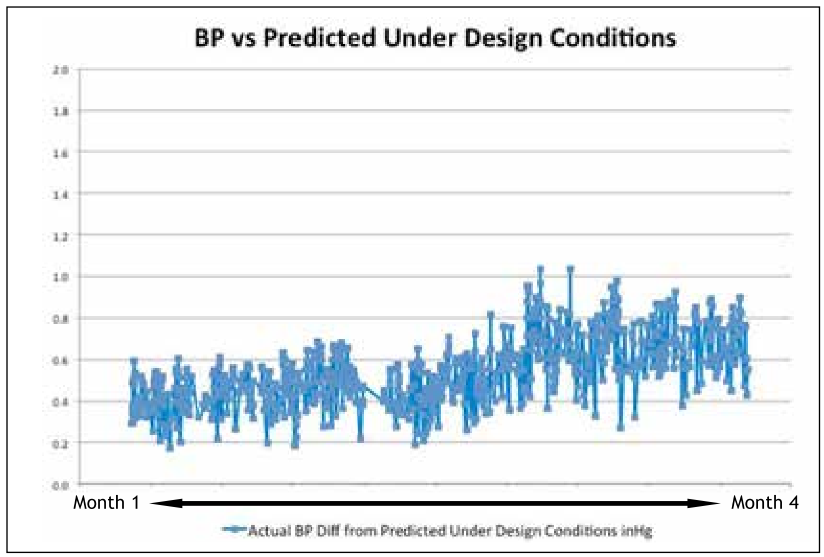

Figure 5 - *Condenser backpressure also dropped when the cooling tower fill was cleaned.*

CONCLUSION

Every power plant wants to be a good corporate citizen of the community in which it resides. Every power plant wants to minimize its environmental impact. And every power plant needs to balance those desires with the needs of the community for reliable, low-cost power. This plant satisfied all of these needs through the use of the OMNI program and innovative water treatment programs. In addition to reducing their operating costs by $100,000 per year, they also reduced their greenhouse gas emissions by 3,680 metric tons by reducing their fuel use by 2,000 short tons per year.

[2]Heating Value of coal: 12,550 BTU/lb

Nalco Water, an Ecolab Company

North America: 1601 West Diehl Road • Naperville, Illinois 60563 • USA
Europe: Richtistrasse 7 • 8304 Wallisellen • Switzerland
Asia Pacific: 2 International Business Park • #02-20 The Strategy Tower 2 • Singapore 609930
Greater China: 18G • Lane 168 • Da Du He Road • Shanghai China • 200062
Latin America: Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100

nalco.ecolab.com

 10/17 CH-1272

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