Combined Cycle Plant uses Nalco Water PURATE™ technology to improve generating efficiency

NALCO Water
An Ecolab Company

CASE STUDY – POWER
CH-2096

SITUATION

A power plant's main condenser has more impact on overall thermal efficiency than any other unit process. In today's competitive, deregulated power market, low heat rates and operating costs are a real competitive advantage. Power plants also want to be good corporate citizens of the communities in which they operate and good stewards of the environment.

A combined cycle plant[1] in the southwest is a clean, natural gas-fueled, 4x2 operations. The cooling tower make-up water comes from two local waste treatment plants. Using impaired waters like this reduces a plant's environmental footprint. It's also a low-cost source of water for industrial purposes, a great alterative to fresh water from a well or publicly owned treatment works.

Impaired waters are highly variable and nutrient-rich, which makes using them in cooling water applications difficult. The challenge for this plant was to make use of this inexpensive, abundant, impaired water source without risking the asset integrity of the plant.

TECHNOLOGY

Logistics were a challenge too. The plant received three truckloads of 12.5% hypochlorite every week. The time, expense and hassle associated with managing those deliveries and the opportunities for error prompted plant management to look for better solutions.

Bleach application presented other challenges. A failure in the bleach feed system quickly resulted in microbial fouling. The nutrient-rich make-up water created a perfect environment for microbial growth.

[1] *Each power block produces 758 megawatts (MW).*

CUSTOMER IMPACT	eROI℠	ECONOMIC RESULTS
86% reduction in truck deliveries	SAFETY	Reduced opportunity for errors and chemical exposure
Improved condenser efficiency	ENERGY	$29,000/year fuel cost reduction

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

Figure 1 shows the impact of a bleach pump failure. On the evening of April 13, the bleach pump failed. By mid-morning the next day, the condenser back pressure penalty – the difference between current back pressure and design back pressure under equivalent conditions – had increased 0.3" Hg(A).

Addressing all the mechanical, operational and chemical challenges associated with using this make-up water source required a suite of Nalco Water technologies. Most importantly was Nalco Water's PURATE Technology, an innovative, safe, reliable, highly-efficient, on-site chlorine dioxide generation technology. The cooling water chemistry was controlled using Nalco Water's industry-leading 3D TRASAR Cooling Water technology. The impact of the cooling water treatment change was documented using Nalco Water's OMNI Condenser Performance program.

The PURATE system was started on May 16. Within two days, condenser back pressure penalty had declined to normal levels, showing the clean-up achieved by employing the new technology. The chlorine dioxide generated by the PURATE system is highly effective. It is a quick-acting, highly active oxidizer, the perfect solution for a system like this.

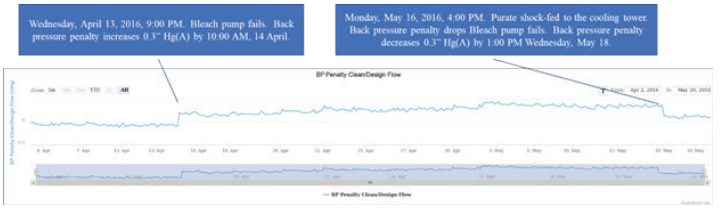


Figure 1: Impact of microbial control on Unit 1 condenser back pressure.

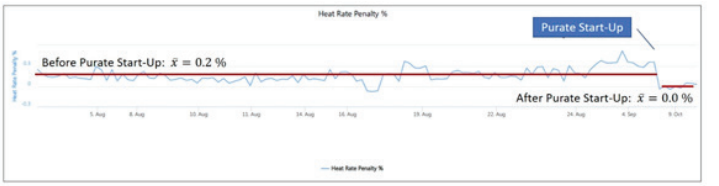
After seeing the impact PURATE had on Unit 1, the technology was implemented on Unit 2 on September 3rd 2017.

The engineering staff at the plant regularly looks at Heat Rate Penalty – % variance from design – to assess performance. Prior to implementation of the PURATE program, the plant's Heat Rate Penalty on Unit 2 was 0.2%. When the PURATE program started on September 18, 2017, the Heat Rate Penalty dropped to 0%. The plant's condenser was operating at design efficiency. The 0.2% decline in Heat Rate Penalty % represents a 0.2% fuel use reduction[2].

EPRI Norms for changes in condenser backpressure

A 1" change in backpressure represents a:

- 1% efficiency change in a combined cycle plant
- 2% efficiency change in a coal-fired plant
- 3% efficiency change in a nuclear plant



The decline in Heat Rate Penalty % means the unit can produce its design output at the highest possible efficiency, maximizing revenue and preventing the need to buy power on the spot market.

Even during times of low power demand and prices, a 0.2% improvement in Heat Rate has a positive financial benefit. In a typical combined cycle plant (Heat Rate = 7,655 Btu/kWh), a 0.2% change in Heat Rate impacts fuel use by 0.2%. For a Net Annual Generation of 2.0 million MWh and a natural gas price of $1.025/Mcf, a 0.2% improvement means a $29,000/year cost reduction. More importantly than the cost reduction is the knowledge that the condenser is free of deposits and fouling. This maximizes asset life and ensures that when demand increases, the plant will be ready to deliver at peak efficiency. The plant is doing the preventative work today that will pay dividends in the future.

CONCLUSION

Nalco Water delivers results and performance to customers through a combination of on-site technical expertise and innovative technology. This combined cycle plant utilized a suite of Nalco Water technologies to safely, effectively and economically use a poor quality water source to meet their cooling water needs.

Nalco Water's PURATE Technology improved microbial control. 3D TRASAR Cooling Water Technology delivered tight control of the chemical program. The OMNI Condenser Performance program documented performance and quantified the financial and performance impact of the treatment changes.

[2] *Nalco Water OMNI Condenser Performance program uses industry standard calculations to compare current condenser performance to design, highlight areas for improvement and guide troubleshooting efforts. Use of the program allows an engineering staff to find, fix and prevent any problem that occurs in a power plant condenser.*

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