California Combined Cycle Plant Uses Nalco Water's OMNI Condenser Performance Program to Reduce Annual Fuel Costs By Over $500,000

NALCO Water
An Ecolab Company

CASE STUDY - POWER
CH-2089

BACKGROUND

This 825-MW California combined cycle plant – like all power plants – assesses condenser performance frequently. The OMNI Condenser Performance program links data from the plant's data historian to other cooling water data and provides focused, fast information from which plant and Nalco Water representatives can find, fix and prevent efficiency-robbing condenser problems. The OMNI program performs EPRI- and industry-standard calculations and compares current condenser performance to design under similar conditions. This case reveals the value associated with using the program to routinely assess condenser performance.

During the summer of 2017, the Nalco Water sales engineer at the plant reviewed condenser performance data as part of her service plan. The OMNI report showed a condenser cleanliness factor well below the design specification of 85%.

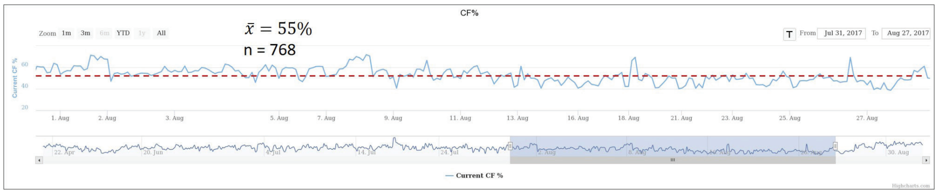

Figure 1: The average cleanliness factor of 55% for August was well below the design cleanliness factor of 85%.

Cleanliness factor (CF%) is the power plant equivalent of a Check Engine light. When a Check Engine light comes on, you know something has happened – loose gas cap, clogged fuel injector, worn timing belt, failed catalytic converter – but the light does not give you any additional information. Cleanliness factor is a catch-all metric and the risk of drawing the wrong conclusion from cleanliness factor is high. For example, both air in-leakage and condenser scaling – two very different problems with very different solutions – can manifest themselves as a degradation in cleanliness factor.

CUSTOMER IMPACT	eROI℠	ECONOMIC RESULTS
Reduced Fuel Use	ENERGY	$681,000/year

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

The OMNI Condenser Performance program gives better visibility than one catch-all metric and directs troubleshooting efforts. When reviewing all the available data, the problem appeared to be an air leak.

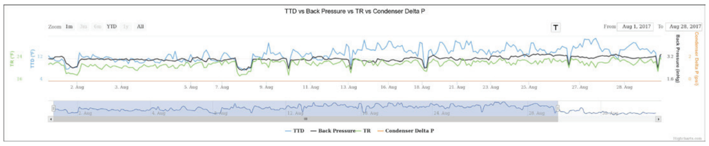

Figure 2: High Backpressure and Terminal Temperature Difference (TTD) with normal Delta P and Temperature Rise (TR) indicate an air leak. The data confirmed the diagnosis.

Condenser Problem	Back pressure	Terminal Temperature Difference - TTD	Temperature Rise - TR	Delta P	Condensate Dissolved Oxygen	Condensate cation conductivity and / or sodium
Scaling	HIGH	HIGH	normal	normal	normal	
Microbial Fouling	HIGH	HIGH	normal	HIGH	normal	
Air-Binding / Air Blanketing	HIGH	HIGH	normal	normal	HIGH	
Macrofouling	HIGH	HIGH	HIGH	normal		
High CW Inlet Temperature	HIGH	normal	normal	normal		
Low CW Flow	HIGH	normal	HIGH	normal		
Steam-Side Vacuum Priming Problem	HIGH	HIGH	HIGH	normal		
Tube Leak						HIGH

Figure 3: Key Plant Metrics. HIGH readings are defined in reference to condenser design specifications.

Once the problem had been identified, a contractor was hired to look for air in-leakage. The contractor applied a tracer gas and located several leaks in the LP turbine hood. Some leaks were more severe than others and they were repaired in two groups over the next 30 days.

The impact on plant performance was quickly realized. Megawatthours penalty dropped, as shown in Figure 5. Cleanliness factor increased, as shown in Figure 6. Average condenser backpressure decreased from 3.2″ to 2.3″, an improvement of 0.9″ and an efficiency gain of 0.9%. The estimated fuel cost reduction was about $535,000 and the plant gained 2.6 MWh in generating capacity, a potential revenue gain during high demand periods.

$$3{,}089{,}841\ MWh \times \frac{7{,}545{,}000\ Btu}{MWh} \times \frac{ft^3}{1{,}060\ Btu} \times \frac{\$3.44}{1000\ ft^3} \times 0.9\% = \$681{,}000$$

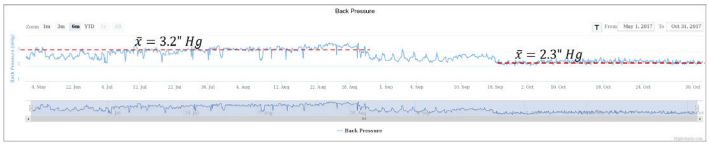

Figure 4: Backpressure decreased from 3.2″ Hg to 2.3″ Hg, an improvement of 0.9″ Hg and an efficiency gain of 0.9%

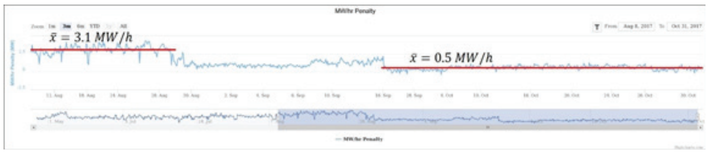

Figure 5: MW Penalty declined 2.6 MW/hr after the air leaks were repaired.

Figure 6: Cleanliness Factor increased 25.7% following the air leak repairs.

CONCLUSION

On a regular basis, the Nalco Water sales engineer retrieves data from the plant's Data Historian, analyzes it and reviews the reports with the plant engineering staff. Routine review of condenser performance data detects any problems early and prevents performance degradation. That keeps operating costs low and keeps the plant competitive in today's power market[1].

[1] 825 MW combined cycle plant, 43% capacity factor, Net annual generation: 3,089,841 MWh, Heat Rate: 7,545 BTU/kWh, Natural Gas fuel value: 1,060 Btu/ft3, Fuel cost: $3.44/Mcf

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