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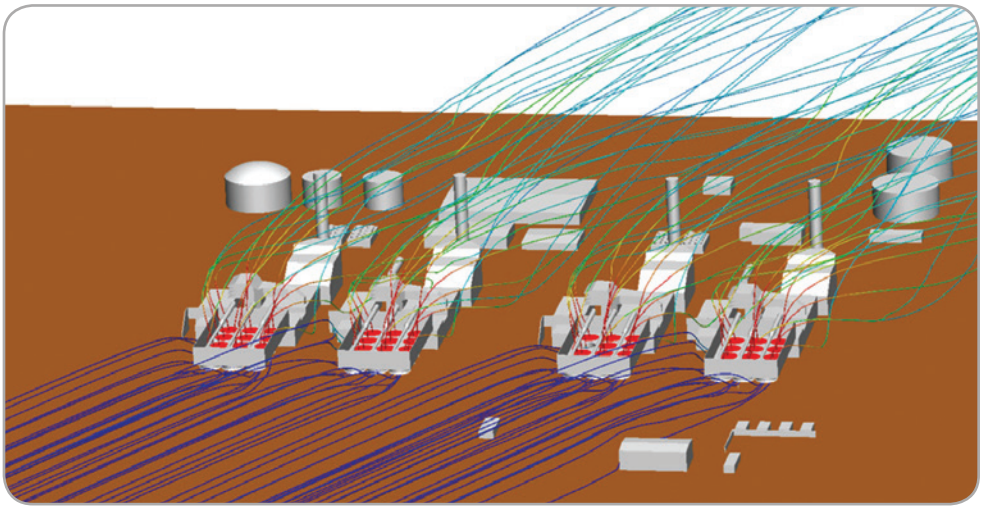
Innovation Through Insight

Large Combined Cycle Power Plant Utilizes CFD Modeling to Predict the Negative Cross Wind Effects on a Large Air Cooled Condenser

Rand Simulation Models Plant Airflows to Improve ACC Efficiency and Reduce Turbine Backpressure



> **"Turbine derates due to increased backpressure caused by hot weather winds were costing us significant generation loss. With Rand Simulation's expert CFD analysis, we were able to identify problem areas to increase overall air cooled condenser effectiveness."**
>
> **Plant Manager**

The Challenge

Air cooled condensers (ACCs) cool the steam turbines, which are the primary component in generating power. ACCs condense exhaust steam and return condensate to the boiler without water loss. During the summer at a large power generation plant in the southwest, given particular wind patterns, hot air from huge fans blowing air off the condensers was found to re-entrain into the suction side of the ACC train. When the ACCs re-ingested this warmer air, it reduced their efficiency and introduced increased backpressure into the steam turbines. The company was experiencing unit derates in power generation plants when the summers were warm and the wind blew from a certain direction. And summer time was the peak period where the majority of profits were made given increased customer demand for electricity during those months.

"We had been dealing with summer power output decreases due to hot weather winds for almost ten years," said the plant manager. "We tried various solutions through trial and error, but it was labor intensive and nothing completely solved the issue. We knew that a computational fluid dynamic (CFD) analysis of the airflow around the plant and across the ACCs could help better position air flow wind deflectors and make these units work better, but we had dismissed it as too costly."

When a supplier introduced Rand Simulation's CFD team to the power plant's parent company, they discovered that CFD for plant-level analysis was not only cost effective, but also the ideal way to explore how to improve ACC and fan performance. After a recent project in the northeast, the plant engineers could see the clear ROI in CFD analysis so they began to work with the Rand Simulation CFD Analysis group as well.

The Solution

Plant engineers outlined their goals. They wanted to increase the overall fan flow rate and to improve flow uniformity across all the fans to improve efficiencies during the summer months.

Working remotely via phone and desktop sharing, Rand Simulation CFD experts quickly built representative 3D CAD models of the plant from photographs and drawings. The team used the models to simulate existing airflows and air temperatures around the facility, including ACC and fan stack exhaust, as well as wind speed, direction and temperature. The models showed that changing the direction of the airflow on the inlet side of the ACC fans would provide greater fan throughput, thus improving power output.

“It was a highly collaborative effort,” said the plant manager. “We had several calls a week and both sides would throw in suggestions for improvement as we saw the models evolve. The Rand Simulation team acted as a true partner and pushed us to get the information they needed and spent a lot of time to get us to where we wanted to be. They pushed forward towards the goal as hard as we did.”

Rand Simulation studied airflow patterns beneath the ACC units and identified adverse flow patterns that could affect ACC performance. They also assessed the conditions that promoted hot air re-ingestion into ACC units and confirmed warm air entrainment into the gas turbine inlets. With the wind and airflow conditions modeled, Rand Simulation and plant engineers exploredhow different corrective devices might improve the system, including louvers and directing plates.

Long-Term Benefits and Results

Improved airflows for ACC efficiency improvements

In the end, the models showed that directing plates would work best. The models showed that angled direction plates set on the inlet side of the ACC fans would increase overall airflow by 2% and flow balance by 42%. “Being able to view CFD analysis data visually allowed us to gain a better understanding of current and future airflows,” said the plant manager. “With this data, it became a matter of running different scenarios to find the best fit.”

“Great work that increased from the original scope. Now that’s a rare trait in suppliers,” said the plant manager. “On a scale of 1-10, Rand Simulation certainly earned a 10. They were good communicators with integrity. They knew their stuff, but were also flexible and willing to listen to our ideas. They also took the time to explain the technical aspects, so that everyone was always on the same page.”

Reducing downtime at other plants in the future

This large energy producer runs many generation plants across the US, and many of them experience similar issues. “We plan to get Rand Simulation to work on some of our other plants that are having similar backpressure issues,” said the plant manager. “I am very pleased with the results of this work. We were lucky for our chance introduction to Rand Simulation, because there really is no one else out there doing CFD for plant design at their level.”

About Rand Simulation

Rand Simulation is focused on helping organizations bring their product vision to reality through incorporating engineering simulation technology into the product development process. Rand Simulation caters to product development organizations looking to compress the design process, maximize innovation, strengthen competitive differentiation and grow bottom-line profitability. Rand Simulation serves as both a North American reseller of Ansys engineering simulation software and as a trusted design consultant offering insights gained on over 3,000 design projects using engineering analysis software to balance design performance with size, cost, DFM and aesthetics.

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