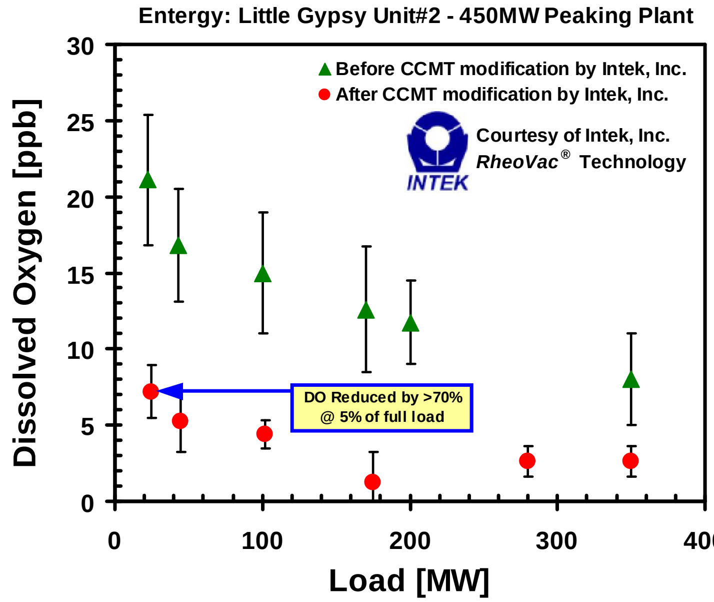
Through Retrofit, Entergy's Little Gypsy Reduces DO by 70%

Summary
Entergy's Little Gypsy Unit 2 is a 450 MW unit originally designed for base load operation. Since changing over to peaking power operation, the plant has had problems with excessive dissolved oxygen (DO), especially during periods of low load. Intek, Inc. was contracted to use their Comprehensive Condenser Model and Theory (CCMT) and methodology to identify and correct design aspects responsible for the high DO. The result was a 70% reduction in DO at only 5% of full load.

Background

Since 1994, Intek has collected operating data from condensers around the world. With this data, Intek has observed the operations and behavior of various condenser configurations. These observations, coupled with years of experience in power generation, led Dr. Joseph Harpster, Intek's President, to develop the Comprehensive Condenser Model and Theory (CCMT). The CCMT is verifiable because it mirrors and predicts the condenser behavior observed by Intek and power producers over the years. The CCMT differs from traditional condenser modeling programs, such as those that utilize computational fluid dynamics and finite element analysis exclusively, because it explains steam and air flow within the condenser, including the air removal section.



Problem Description

When operating at full load, DO levels at Little Gypsy were acceptable. When operating at lower load, DO was considerably higher. Being a peaking plant, Little Gypsy ran at an idle power of 20-40 MW half of the time. At this low level of operation, DO reached high levels that are unacceptable for Entergy and proved problematic for the Little Gypsy Plant.

Numerous attempts were made to lower the DO through repairs and operating procedure changes. Though air in-leakage was measured at only 4 to 8 SCFM, several fruitless searches were made for leaks. Many minor repairs were made, but all had little or no effect on DO. Little Gypsy engineers experimented with using different combinations of vacuum pumps and cleaned the vacuum pump seal water heat exchangers; but DO remained at unacceptable levels. A dam was even built to flood the standby condensate pump seals, leading to the replacement of both seals, yet DO refused to budge.

Frustrated, Mr. Messina contacted Dr. Harpster at Intek, Inc. Entergy's Little Gypsy and Intek, Inc. had an established relationship that began with Little Gypsy's use of the RheoVac instrument in 1998. Once Mr. Messina shared the construction drawings and plant data with Intek, it was immediately clear to Dr. Harpster that the DO could be attributed to the design of the condenser.

As a long time user of Intek's *RheoVac* system, which measures air in-leakage and other indicators of a condenser's overall health, Little Gypsy's Chemistry Supervisor, Mr. Joseph Messina, was keenly aware of Intek's long-standing commitment to solving condenser-related problems. Because Dr. Joseph Harpster had spent the last several years teaching and researching the causes and solutions for some of the more vexing shell-side condenser related problems, Mr. Messina was confident in his ability to address his DO issue. By properly using Intek's *RheoVac* condenser monitor and knowledge of the condenser performance model, Little Gypsy understood that their air in-leakage was below pump capacity and the measured high DO could be caused by condenser design deficiencies.

Answers

So as to reach a complete understanding of Little Gypsy's problems, Intek utilized their four-step condenser analysis program. In order to identify the design problems, Intek studied Little Gypsy's available condenser drawings and operating plant data to locate suspected trouble areas. Once the problems were identified, Intek verified the information by performing a condenser inspection and detailed analysis. Using the CCMT, Intek determined the extent of the condenser problem, and identified methods that could be employed to improve performance. During this stage, Intek also considered the amount of time available for the fix, in this case a two-week outage. The last step was the delivery of drawings and the right to use the patented information. Little Gypsy then contracted an outside firm to perform the work. The identified work included modifications to a flawed air removal section, and a circulating water tube bundle subsection to better accommodate high and low load. In addition, work was performed to correct conditions that contributed to excessive sub-cooled condensate and increase deaeration. Intek provided inspection of work and acted as technical advisor.

Intuitively, high DO is thought to be a necessary evil of low load operation. At lower loads, condenser pressure is lower, moving the vacuum further up the annulus, exposing more valves, ports and openings, leading to higher air in-leakage. The higher air in-leakage increases the opportunity for the gases to dissolve. Through Intek's efforts, it has been shown that plants operating at lower loads do not need to endure high levels of DO.

Resolution

After the retrofit was complete and the unit returned to operation, the results were immediate and dramatic. At 22 MW, DO was decreased from 22 to 7 ppb and at 180 MW DO was reduced from 13 ppb to 2 ppb. The guaranteed projection level was 10 ppb. The key to the success of the program was the unique understanding of condenser dynamics that Intek has pioneered and promoted for the past seven years. Because of the new information provided by *RheoVac* systems, Intek was able to develop the unique CCMT based program enabling their technical team to recognize, explain, and correct condenser deficiencies that have gone unnoticed or unsolved for over half a century.