Xcel Energy

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Company Background

Xcel Energy is a major natural gas and electricity provider operating in eight states across the West and Midwest to power over 3.5 million homes and businesses. Xcel generates energy from a variety of sources, including coal, natural gas, nuclear, hydro, wind, and solar. They have undertaken multiple repowering projects, converting coal plants to combined cycle natural gas plants, and have invested heavily in solar and wind energy, leading the way in renewable power generation. Additionally, Xcel supports customer initiatives to reduce power demands by providing rebates for energy efficient changes.

"Working at Xcel Energy gave me a fantastic opportunity to translate my coursework to a practical, industrial engineering setting. This experience gave me a chance to gain technical knowledge, develop project management skills, and improve my communication abilities. Through this internship I was able to learn a lot about the power generation industry and reduction strategies that can be used in any field." ~CL

Project Background

Black Dog and Riverside, the sites of this project, are repowered coal facilities converted to natural gas combined cycle plants. Combined cycle generation plants require large amounts of high purity water for various process and auxiliary systems. The makeup water at both Riverside and Black Dog comes from onsite wells and is purified with reverse osmosis and demineralization systems, which were the focus of water conservation efforts at both plants. Leak detection, overall system analysis, and monitoring equipment improvements were used to find opportunities for water conservation, identify potential efficiency improvements, and optimize system performance.

Incentives To Change

Xcel Energy endeavors to decrease water usage and improve heat rate, creating more efficient processes, which reduce environmental impact and minimize operating costs. These improvements reduce the amount of water and natural gas required per MW-H, which lowers chemical consumption, decreases the carbon footprint, and improves profit margins. Finally, decreased flows reduce the demand put on treatment systems and pumps, resulting in extended unit lifetimes, reduced maintenance, and significant savings.

SOLUTIONS

Prevent Permeate Tank Drainage

The current design of the reverse osmosis 1 (RO 1) permeate tank and RO 2 buffer tank allow product to be siphoned out during standby conditions. It is recommended to eliminate this drainage by adding a vacuum break to the RO 1 concentrate drain line and relying on the overflow drain and PLC logic to control RO 2 tank levels. This change has been completed and will result in saving 730,500 gallons of water and $520 annually.

Increase Mixed Bed Throughput

Tuning the caustic injection before RO 2 and bypassing extra piping will improve pH control and reduce CO_2 levels in water going to the mixed beds. This will increase the throughput and reduce the number of offsite regenerations needed. This recommendation is in progress and will result in saving $16,000 annually.

Repair Leaking Valves

Both plants have a small number of leaking valves that account for most of the steam cycle water loss and significantly increase heat rate. It is recommended that Xcel repairs or replaces these valves at the next opportunity. When implemented, this recommendation will save 756,000 gallons of water, 9,300 MMBtu, and $29,000 annually.

Optimize Rotor Air Cooler Blowdown

It is recommended that Xcel connect and collect monitoring equipment data to track rotor air cooler water chemistry. Once monitoring capabilities are implemented, blowdown should be reduced as much as possible within Electrical Power Research Institute chemistry guidelines. This change is being tested and could result in saving as much as 21,800 gallons and $55 annually.

Optimize Water Softeners

Improvements to procedure adherence and increases in the time between softener regenerations is recommended. A leaking drain valve should also be repaired and a hardness monitor should be installed to ensure proper water quality. These measures will reduce the total number of regenerations. This recommendation is in progress and will save 545,800 gallons of water, 25,400 lbs. of salt, and $3,340 annually.

Reduce Auxiliary Water Use

Systems that are only used seasonally should be completely isolated when they are not in use. Isolating the building heating system from the steam system and closing it off from the makeup water header will significantly reduce summer water use, with no impact to operations. This change was completed and will result in saving over 4 million gallons of water and $9,720 annually.

Heat Rate Calculations

It is recommended that engineering staff complete a quarterly review of the heat rate calculations that were added to the control system to identify inefficiencies and develop projects. This recommendation is in progress with unknown environmental and cost savings.

Recommendation	Annual Reduction	Annual Savings	Status
Prevent Permeate Tank Drainage	730,500 gallons	$520	Complete
Increase Mixed Bed Throughput	6 regenerations	$16,000	In Progress
Repair Leaking Valves	756,000 gallons 9,300 MMBtu	$29,100	Recommended
Optimize RAC Blowdown	21,800 gallons	$55	Testing
Optimize Water Softeners	545,800 gallons 25,400 lbs salt	$3,340	In Progress
Reduce Auxiliary Water Use	4,032,000 gallons	$9,720	Completed
Heat Rate Calculations	Further Analysis Needed	Variable	In Progress