FMC Chemicals:
Burner Management System Upgrade Improves Performance and Saves Energy at a Chemical Plant

Benefits

- Saves $911,000 annually
- Saves 250,000 MMBtu of natural gas annually
- Improves boiler performance
- Achieves a 1.5-month simple payback

Application

Burner management systems continuously monitor and control parameters of boiler combustion. Such systems that function poorly can lead to boiler malfunctions, production downtime and wasted energy. Ensuring that a burner management system operates properly can improve boiler efficiency and reliability.

Summary

In 2002, FMC Chemicals Corporation improved the efficiency of two large coal-fired boilers at its soda ash mine in Green River, Wyoming. The company improved the boilers' operation by upgrading the burner management system (BMS). Before the upgrade, a continuous supply of natural gas was required to maintain the appropriate flame conditions required by the flame detection system of the BMS. After performing a system-level evaluation, plant personnel realized that upgrading the BMS would allow them to discontinue the natural gas supply without compromising boiler operation. The BMS upgrade project is yielding annual energy savings of $899,000 and 250,000 MMBtu. In addition, the components within the improved BMS require less servicing, saving $12,000 per year in maintenance costs. Also, a smaller inventory of spare parts is needed, and boiler reliability and plant safety are better. With total annual project savings of $911,000 and total project costs of $110,000, the simple payback is just over 6 weeks.

Company/Plant Background

FMC Chemicals Corporation is one of the world's foremost, diversified chemical companies with leading positions in agricultural, industrial and consumer markets. The company was founded in 1883 and today has annual sales in excess of $5 billion. FMC Chemicals provides goods and services to companies around the world. The company's products are used to improve the delivery of medications, to enhance foods and beverages, to power batteries, and to protect crop yields and lawns. FMC products also advance the manufacture of glass, ceramics, plastics, pulp and paper, textiles and other products. In 2001, FMC Chemicals became an Allied Partner of the Best Practices Program, which is part of the Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy (DOE). Allied Partners are manufacturers, trade associations, industrial service and equipment providers, utilities, and other organizations that work with DOE to promote energy efficiency.

The Green River plant is part of the Alkali Chemicals division of FMC Chemicals. The facility has 900 employees and is both a mine and a chemical processing plant, producing natural soda ash as well as a range of other alkali products including various grades of sodium bicarbonate, sodium sesquicarbonate and caustic soda.

Approximately 5 million tons of trona, the ore removed in the mining process, is processed through the facility annually. The site is equipped with seven boilers and two pulverized coal-fired boilers, each capable of producing 650,000 pounds per hour (lbs/hr) of steam each. The facility also has five natural gas-fired boilers, each producing between 90,000 lbs/hr and 225,000 lbs/hr of steam. Steam is nominally produced at 600 pounds per square inch gauge (psig) and 750ºF (superheated). Typical steam demand averages 1,100,000 lbs/hr.

Project Overview

In December 2001, the Green River Plant's personnel underwent some DOE-sponsored training on steam system efficiency and methodologies for evaluating industrial steam systems. Part of the training included courses on two BestPractices software tools: the Steam System Scoping Tool (SSST) and the Steam System Survey Guide (SSSG). Upon completion of the training, the BestPractices software tools were used to evaluate the boilers. Boiler reliability at the plant was found to be below average and it was decided to examine the Burner Management System's operation to determine whether it could be improved.

FMC Chemical's Green River Plant

Upon reviewing the Burner Management System's flame detection system, a utilities results engineer found that it was ineffective. The existing flame detection system was part of the BMS on the two coal-fired boilers, which were installed during a plant expansion in 1974. The burners were capable of burning natural gas to continue boiler operation in a back-up capacity in case coal was unavailable. At the time of installation, the flame detection system was capable of operating reliably with only coal being burned by the igniters. Over time, the reliability of the flame detection system deteriorated, and this led to boiler shutdowns. At one point, a decision was made to continuously supply natural gas along with coal to the burners in order to maintain the flame conditions required by the flame detection system and avert boiler shutdowns.

The utilities results engineer also realized that the flame detection system was more maintenance-intensive than current flame detection technology because it required two separate viewing sensors—

ultraviolet (UV) and infrared (IR)— to function properly. Because of the separate viewing sensors, a greater inventory of spare parts was required for routine maintenance.

Project Implementation

After some investigation, the utilities results engineer conceptualized the Burner Management System upgrade project. However, before the project could be implemented, the engineer needed management approval. To gain approval, he tested the new flame detection system on a trial pulverizer. The test unit was fitted with a new flame detection system for 2 months. During this period, the flame detection system functioned perfectly with the burner using only coal.

Coal mining operations at the Green River Plant

The successful test proved that supplemental natural gas was not needed for safe and effective boiler operation. Soon after the test, the existing BMS was replaced with the new system that included four flame detectors. Each of the eight pulverizers on the coal-fired boilers had UV and IR sensors. The utilities results engineer also installed a 4-conductor shielded cable to replace the 30-year-old wiring. Additional remote light-emitting diode (LED) barographs were installed to allow the operator to view flame signal strength. Finally, the new BMS came with a software tool that enables boiler operators to monitor the operating performance of each signal processor and viewing sensor. This additional capability enables the operators to control all BMS functions and to troubleshoot and take preventive actions.

Project Results

By replacing the poorly functioning Burner Management System, the Green River plant was able to discontinue the natural gas supply to the coal-fired boilers. Consequently, the plant improved boiler performance and saved an impressive amount of natural gas. After the improvements the percentage of steam produced by burning coal rose from 93% to almost 100%. Moreover, the boilers now operate more reliably and are less prone to accidental shutdowns due to weak flame perception.

Because the plant eliminated natural gas supply to the burners, FMC's annual energy savings at the Green River facility are $899,000 and 250,000 MMBtu. This represents a 60% decrease in annual natural gas purchases to supply the boilers. Also, because the new BMS uses identical signal processors and viewing sensors for both IR and UV signals, it requires less equipment. This in turn decreases the number of spare parts required, yielding annual maintenance savings of $12,000. With total annual savings of $911,000 and project costs of $110,000, the BMS upgrade project achieved a 6-week simple payback.

Lessons Learned

To maintain boiler reliability and proper operation, burner management systems need to be inspected periodically. In the case of FMC Chemicals' Green River plant, a malfunctioning flame detection system led to boiler shutdowns and had an adverse impact on production. Before the project, natural gas was supplied to the coal-fired boilers, in addition to coal, to reduce the probability of weak flame perception by the flame detection system. However, this measure concealed the ineffectiveness of the Burner Management System for years and caused unnecessary natural gas consumption. Once the BMS was evaluated in accordance with the principles in the U.S. DOE's BestPractices Steam System Survey Guide, an appropriate solution was conceived and implemented. By installing a more optimal BMS, plant personnel enabled the burners in the coal-fired boilers to operate effectively by burning only coal. Thus, the plant was able to discontinue the supply of natural gas to those boilers. This improved boiler performance and yielded substantial energy savings.

Burner Flame Detection Systems

A burner flame detection system is an arrangement of flame detectors, interlocks, and relays, and is part of the burner management system (BMS). The purpose of the flame detection system is to sense flame operation and to shut off fuel supply if a hazardous condition develops. The flame detection system senses the presence of a good flame and proper combustion, and programs the operation of a burner so that motors, blowers, ignition, and fuel valves are activated when needed, in the proper sequence. In the event of a lost flame signal, the flame detection system signals the burner management system, which then shuts down the associated coal pulverizers in order to prevent a fuel-rich environment in the burner, which is extremely dangerous.

U.S. DOE BestPractices Steam Software Tools

DOE's BestPractices has a suite of tools for evaluating and identifying energy savings potential in steam systems. The primary steam-related tools include the Steam System Scoping Tool (SSST), the Steam System Assessment Tool (SSAT), and the Steam System Survey Guide (SSSG). The SSST is a software tool designed to help steam system energy managers and operations personnel assess their steam systems by profiling and grading steam system operations and management. The SSAT is another software package that allows users to assess potential savings from individualized steam-system improvements by modeling various improvement scenarios. The SSSG provides technical information to help steam system operators and plant managers find major opportunities to improve energy efficiency and productivity. Much of the software can be obtained through the Best Practices Web site at http://www.oit.doe.gov/bestpractices/pubs.shtml, or by calling 877-337-3463.

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BestPractices is part of the Industrial Technologies Program, and it supports the Industries of the Future strategy. This strategy helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together emerging technologies and energy-management best practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

Project Partners

FMC Chemicals Corporation
Green River, WY

Iris Systems, Inc.
Largo, FL (BMS manufacturer)

Diamond Systems
Grapevine, TX (BMS supplier)

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