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OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Benefits

- Saves over $17 million annually
- Reduces emissions of pollutants
- Provides better control over operations
- Improves plant productivity

Applications

Control systems are key components of most manufacturing plants. For facilities with aging control systems, upgrading to modern computer controls will help improve process operation, efficiency, and productivity.

Modernization of Controls Improves Productivity and Reduces Energy Costs at a Large Steel Plant

Summary

In 1996 and 1997, Weirton Steel upgraded the utilities control systems at its main steel manufacturing plant in Weirton, WV. In response to increasing energy costs and the need to remain competitive in the steel industry, Weirton Steel commissioned a comprehensive energy management study of the facility, which provided the basis for an energy management control strategy. The centerpiece of the strategy was a project to replace the plant's antiquated utility control equipment with modern, computer controlled systems that are monitored and controlled from a central control center. The successful implementation of the controls modernization project at Weirton Steel's plant has improved both the productivity and the efficiency of the plant's steam and electrical generating facilities. As a result, the company has been able to save over $17 million annually from reductions in purchased fuels and maintenance costs. Since the project's total cost was about $16 million, it resulted in an 11 month payback.

Weirton Steel Plant

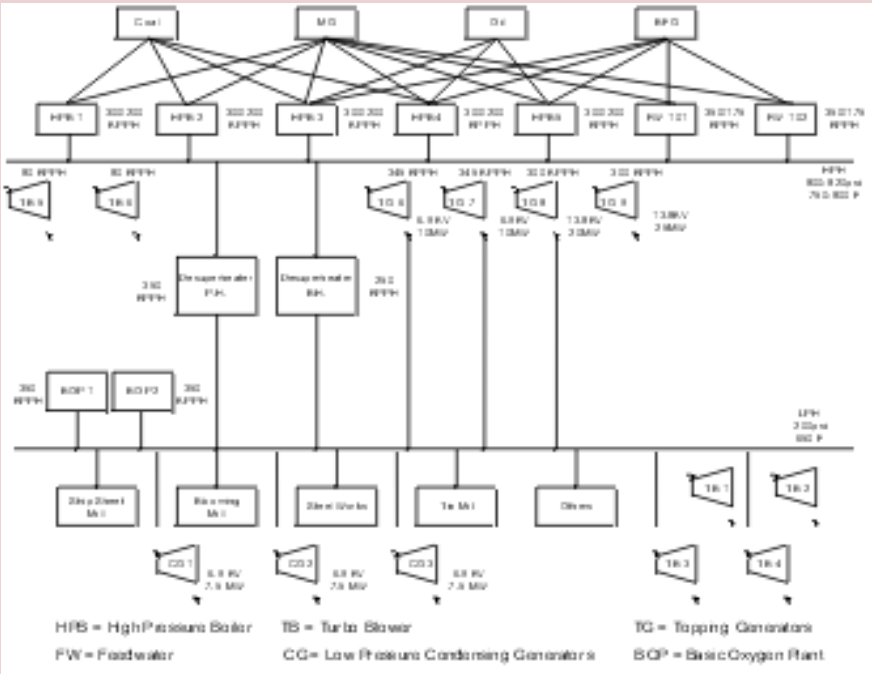
Company Background

Headquartered in Weirton, West Virginia, Weirton Steel has been in existence since 1910. It is the largest industrial employer in the state of West Virginia and is the eighth largest steel producer in the United States. Weirton Steel provides an extensive array of tin mill and sheet steel products as well as steel products for the building and construction market to customers all over the world, including high quality galvanized steel to manufacturers of steel framing for residential and commercial applications. Due to intense global competition, the company is under great pressure to develop ways to produce more efficiently. This pressure led to Weirton's decision to upgrade its facilities and streamline its production processes in order to maintain or increase its market share.

Plant Overview

Weirton Steel's plant in Weirton, West Virginia is one of North America's most advanced integrated steel production facilities. This plant uses several types of industrial utility systems that are fundamental for its production processes. These include a steam system, an electrical generating facility, and a Basic Oxygen Plant (BOP). The steam and electrical generating facilities consist of nine boilers, eight turbine-driven electric generators, raw water pumping facilities, and ancillary equipment that support their operation. The BOP consists of two waste heat boilers and is the linchpin of the steel production process. The BOP takes iron from the blast furnace and places it in a vessel into which an oxygen lance is placed. The injection of oxygen causes carbon to burn off converting the iron to steel. This process creates waste heat that is used in a BOP boiler to generate steam that can be used for power generation and production

Original Steam System Diagram



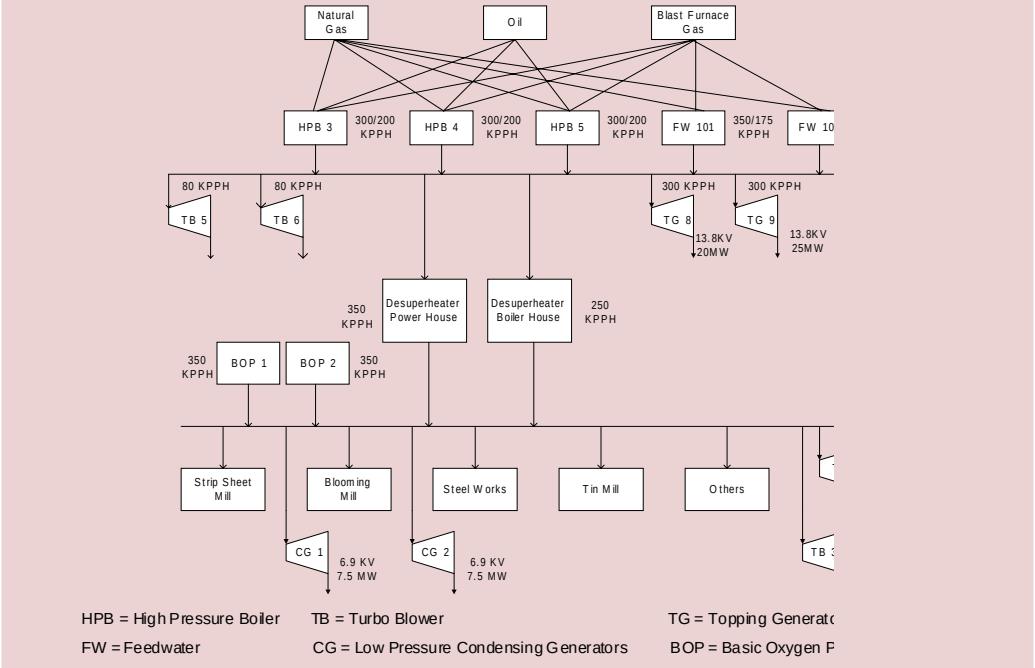
processes. The systems consume oil, natural gas and blast furnace gas (BFG) to produce and distribute steam and electricity to all areas of the plant.

Prior to the project's implementation, the control system at the Weirton plant consisted of manual control equipment that had been installed between 1920 and 1980 in four separate locations within the plant. The plant experiences dynamic production characteristics where the processes' demands for steam, electricity, fuels, and blown air change frequently. With the plant's decentralized manual controls, the control operators were not able to modulate machines and manage the systems optimally, since the control centers, (1) weren't able to provide the operators with the information rapidly enough, (2) provided operators with incomplete information, and (3) were at four separate locations with poor coordination and intercommunications. The boiler controls were not permitting the boilers to react to sudden changes in steam loads and fuel availability, which prevented the plant from maximizing lowest cost fuel usage. Consequently, the plant was using large quantities of purchased energy and allowing sources of heat, such as BFG and steam to be released into the atmosphere.

Project Overview

The Weirton project focused on upgrading the control systems and instrumentation on two department boiler houses, the power house, and the BOP boilers. A control center was constructed and made to interface with the new control systems. The unit operation upgrades are as follows:

Revised Steam System Diagram



Steel Works Boiler House

- A new operator control room was built with local distributive control for boilers 3, 4 & 5. In addition, the instrumentation was upgraded on boilers 3, 4 & 5 as well as on their ancillary equipment.
- A new electrically driven feedwater pump with associated piping and controls was installed.
- A new burner management system was put in place on boiler #5.
- The new boiler controls, as well as the desuperheater controls, were configured to interface with the control center.

Foster Wheeler Boiler House

- The operator control room for boilers 101 & 102 was upgraded as was their instrumentation, controls and ancillary equipment.
- All new boiler controls were made to interface directly with the control center.

Power House

- The instrumentation, controls and hydraulic governors on turbo generators 6, 7, 8, 9 were upgraded, as were the instrumentation and controls on turbo blowers 3 & 4.
- The power distribution supervisory control system, electric demand monitoring system, and the electric power monitoring chart recorders were all upgraded.
- A new operator control station was installed.
- All new controls were configured to interface with the control center.

BOP Boilers

- Instrumentation and control on boilers 146 & 147 were upgraded and made to interface with the control center.
- A new operator control room with a control station was installed.

In addition to the specific changes in each part of the plant, fire protection systems were installed for each facility's control system.

Control Center

Project Results

The implementation of new and upgraded controls have resulted in substantial energy savings and improved productivity for Weirton Steel. The plant went from controlling utilities in four separate locations using obsolete technologies and methods to a sophisticated, computerized, ergonomic control center from which two operators supervise all boilers, pumps, blowers and power generation systems. All essential information needed to assess and control operations are displayed on several monitors in real time to allow for optimal decisions to be made as rapidly as possible. The end result is a centralized control strategy that is tremendously more responsive to changes in energy demand patterns, which has led to substantial efficiency gains. The sources of these gains include the controls' increased responsiveness that allows the plant to use less energy since they can modulate various machines more efficiently. In addition, the controls allow the utility systems to use more of the BFG and steam that are by-products of the blast furnaces and basic oxygen plants, leading to less fuel being purchased. Since the new control strategy has been in place, the plant has also been able to reduce its high-pressure steam production by 20%, its BFG bleed by 32%, and the amount of hours spent by plant personnel on plant utilities by 38%. Due to these efficiency gains in the plant's utility system, the plant has been able to take the following items out of service:

- One low pressure condensation generator,
- Three high pressure boilers,
- Two low pressure turbo blowers, and
- Two high pressure topping generators.

In addition, the plant's new control system allows it to use more by-product energy than before, instead of resorting to purchasing fuel for its production process. This has led to a 48% reduction in expenditure on fuels. Since the total cost for the engineering, labor and materials for the new control system was $16,200,000 and the annual savings in energy, labor and fuel came to $17,743,157, Weirton Steel achieved a payback of 11 months. The table on the next page lists the savings according to each utility.

Finally, another benefit associated with the new control system is the sophistication of its statistical and reporting capabilities, which have made it possible for the plant to identify and accurately quantify many additional savings opportunities.

Annual Cost Savings

Cost Source	Annual Savings
Labor	$5,771,527
Low Pressure Steam Generation	$2,951,750
BOP Oil	$1,983,781
Boiler Shut Down	$1,790,420
BFG Bleed	$300,654
BOP Steam	$99,387
# 8 Condenser	$3,404,036
Low Pressure Generator Maintenance	$500,004
Boiler Efficiency	$471,815
1 & 2 Boiler Maintenance	$294,602
Feedwater	$175,181
Total	**$17,743,157**

Lessons Learned

The efficiency of industrial utility facilities is in part a function of the technological sophistication of the equipment that control them. Aging and obsolete control systems can waste energy, lead to excessive investment in capital assets, cause high maintenance costs, and lower productivity relative to plants that have more modern control systems. An overhaul of a plant's control systems that implements the latest and most appropriate technology available can reduce energy use, leverage various utility facilities and improve productivity. By installing well-configured, modern control systems, Weirton Steel has been able to reduce costs and enhance both the productivity and profitability of its steel plant in Weirton, West Virginia.

Industry of the Future - Steel

Through OIT's Industries of the Future initiative, the Steel Association, on behalf of the steel industry, has partnered with the U.S. Department of Energy (DOE) to spur technological innovations that will reduce energy consumption, pollution, and production costs. In March 1996, the industry outlined its vision for maintaining and building its competitive position in the world market in the document, ***The Re-emergent Steel Industry: Industry/Government Partnerships for the Future.***

OIT Steel Industry Team Leader: Peter Salmon-Cox (202) 586-2380

BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve competitiveness over the next 20 years. BestPractices brings together best available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on 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 combined heat and power systems. Another component is the Industrial Assessments Centers, which provide comprehensive industrial assessments to small and medium-size manufacturers.

Project Partners

Weirton Steel
Weirton, PA

For Additional Information, Please Contact:

The OIT Information Clearinghouse
Phone: (800) 862-2086
Fax: (360) 586-8303
http://www.motor.doe.gov

Visit our home page at
www.oit.doe.gov

Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy, EE-20
U.S. Department of Energy
Washington, D.C. 20585

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