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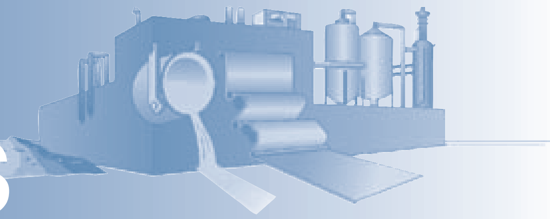

Winter 2005

ISSUE FOCUS:
Unbalanced Voltage

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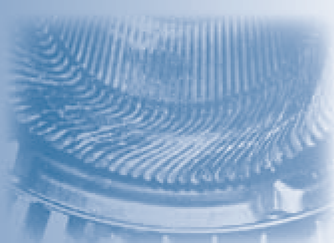

Unbalanced voltage damages motor.* *(page 1)

Stopping a Costly Leak: The Effects of Unbalanced Voltage on the Life and Efficiency of Three-Phase Electric Motors

By Chuck Yung, EASA

Editor's Note: This is the first of a two part series considering some of the energy efficiency issues related to power quality. The Spring issue continues this discussion with an article from the Electric Power Research Institute.

Electrical power quality problems cost U.S. industry $40-150 billion each year, according to some estimates. Most problems originate outside our plant and are therefore beyond our control–for example, outages, voltage interruptions, voltage sag, voltage reductions, and blackouts. Others may be traceable either to the utility grid, plant conditions, or some combination of the two.

The good news is that we can do something about one of the most pervasive (and insidious) power quality problems–voltage unbalance. The bad news is that this problem is easy (and costly) to overlook. At the very least, voltage unbalance reduces motor efficiency, potentially robbing you of the savings you expected to realize by upgrading to EPACT or National Electrical Manufacturers Association (NEMA) Premium™ efficiency motors. More serious consequences include premature motor failure, costly shutdowns, and lost production.

What is unbalanced voltage, and where does it come from?

Voltage unbalance describes the condition when the voltages of all phases of a 3-phase power supply are not equal. You might expect the electricity used by your 3-phase electric motors to be balanced, but it rarely is. According to ANSI C84.1 -1995, Electrical Power Systems and Equipment – Voltage Ratings (60Hz), only 66% of the 3-phase power delivered to industrial plants is within 1% voltage unbalance. In addition, 98% of all voltage generated by electric utilities has 3% or less unbalance. Only 2% of the voltage produced by the electric utilities has a voltage unbalance greater than 3%.

The underlying causes of voltage unbalance are numerous, and may include:

- Lack of symmetry in transmission lines
- Large single-phase loads (for example, arc furnaces, welders, and so on)
- Faulty power factor correction capacitor banks
- Open delta or wye transformers.

Plant conditions that can cause or contribute to voltage unbalance include unbalanced or overloaded transformers, malfunctioning power factor correction devices, cyclical controls, and detuned reactors. Even what's happening at the plant next door or farther up the power line could affect the voltage unbalance at your facility. One plant reported 8% voltage unbalance; the cause was an aluminum plant next door, with predominantly single-phase furnace loads.

The bottom line: if your plant uses 3-phase power and you haven't taken corrective measures already, there's a fairly good chance you have unbalanced voltage.

How to tell

To find out if your plant has a problem with voltage unbalance, measure the line voltages of your 3-phase power supply where it enters the plant and then again at several critical locations within the plant under normal operating conditions. Use those measurements to solve the following equation:

$$\text{Voltage unbalance} = \frac{100 \times \text{Max. deviation from average voltage}}{\text{Average voltage}}$$

For example, if measured line voltages were 455, 460, and 492, the average would be 469 volts (455 + 460 + 492 = 1407 / 3 = 469). The maximum deviation from that average is 23 volts (492 - 469 = 23). To find the voltage unbalance, solve the equation for the average voltage and the maximum voltage deviation:

$$\text{Voltage unbalance} = 100 \times (23/469) = 4.9\%$$

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Stopping a Costly Leak: The Effects of Unbalanced Voltage on the Life and Efficiency of Three-Phase Electric Motors

(continued from page1)

Why you should care

The most apparent effects of voltage unbalance are decreased motor efficiency and performance–both of which affect your company's profitability.

Any given motor's efficiency will vary, depending upon such factors as the type of application, the load, and the supply voltage. In fact, even the efficiency ratings of the new NEMA Premium motors are possible only if they operate on balanced voltage.

That's because motors built to comply with the NEMA standard MG 1 are designed to operate on voltage balanced to within 1%. Operating on a power supply with a larger voltage unbalance will increase the I^2R losses (that is, current squared times resistance) in the rotor and stator, meaning more of the supplied power will be converted to heat and less to work. The motor therefore will run hotter and, consequently, less efficiently. Increased rotor losses also will increase "slip," so the motor will turn a little more slowly and do less work in a given time.

The following table shows how unbalanced voltage affects the temperature rise, losses, efficiency, and life expectancy of a typical 3-phase motor operating at rated load.

Operating on unbalanced voltage also causes the rotor's temperature (heat = losses) to rise. That adversely affects its performance causing it to rotate slower and leading to an increase in its "slip". Slip can be calculated by:

$$\%\ \text{Slip} = \left[\frac{\text{(Synchronous rpm - actual rpm)}}{\text{synchronous speed}}\right] \times 100$$

To get a better grasp of how unbalanced voltage affects motor performance, consider the most common industrial application for electric motors–pumps. Take a 4-pole, 60 Hertz (Hz) pump motor with a synchronous speed of 1,800 revolutions per minute (rpm) that operates at 1,764 rpm at the correct balanced voltage. The slip for this motor would be:

$$\left[\frac{(1800 - 1764)}{1800}\right] \times 100 = 2\%\ \text{Slip}$$

With 3% unbalanced voltage, slip would double, reducing the speed to about 1,728 rpm: (1.0 - .04) x 1800 = 1728

Since the volume of product being pumped varies in proportion to the speed, not only would the motor be 2% to 3% less efficient (referring to the table) when operating from unbalanced voltage, but it also would have to run 3% longer to do the same amount of work. The savings by correcting the unbalanced voltage will roughly equal the sum of the increased losses (reduced efficiency) and the longer run time required.

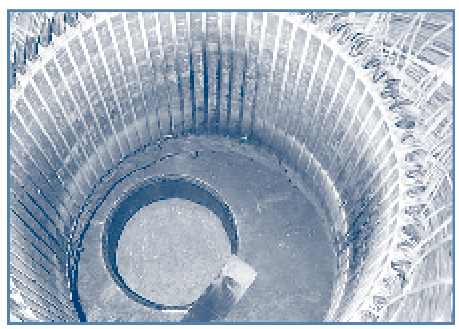
$$\text{Pump flow} = \frac{1728}{1764} = .980 \text{ or } 98.0\%$$

Unbalanced voltage shortens motor life

Another cost of operating on unbalanced voltage is reduced motor life. Recall that operating with a voltage unbalance greater than 1% will increase the I^2R losses in the rotor and stator, causing the motor to run hotter. In fact, the temperature of the windings (in degrees Celsius) will increase by twice the percent of voltage unbalance squared.

$$2 \times (3)^2 = 18^\circ \text{C}$$

Since every 10° C increase in temperature cuts the insulation life in half, a 3% voltage unbalance could reduce the life of the winding to about one-fourth its expected life. A 5% voltage unbalance could reduce winding life to less than the typical warranty period for a new motor ($2 \times (5)^2 = 50^\circ$ C). The accompanying figure illustrates this point.



The windings in this motor were damaged by operation on unbalanced voltage.

% voltage unbalance	Winding temp. (° C)	I^2R losses (% of total)	Efficiency reduction	Expected winding life (years)
0	120	30%	–	20 years
1	130	33%	Up to 1/2%	10
2	140	35%	1 - 2%	5
3	150	38%	2 - 3%	2.5
4	160	40%	3 - 4%	1.25
5	180	45%	5% or more	Less than 1

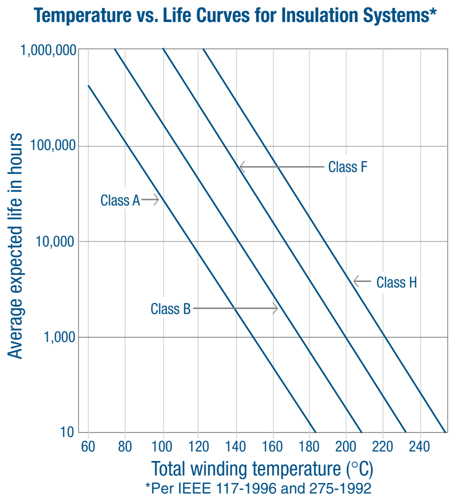


Figure 1. For every 10° C increase in winding temperature, insulation life is cut in half.

Factor in replacement or repair costs for premature motor failures, unscheduled downtime, and lost production, and the true cost of unbalanced voltage can be much higher than the cost of the wasted electricity–possibly as high as a factor of 10. The table below shows the cost of downtime for some representative industries.

Industry	Cost of downtime, $ / hour
Pulp & Paper	15,000
Petro-chemical	150,000
Computer manufacturing	$4 million per incident

Cost of downtime for various industrial segments.

How can we correct it?

The first step in correcting the problem is to measure the voltage unbalance in your plant. Especially if the unbalance exceeds the utilities' standard of 3%, make your utility aware of it.

Next, measure the line voltages at several key locations in your plant to identify conditions that cause or contribute to unbalanced voltage. A number of products are available to help you correct the problem. At one end of the spectrum are basic reactors with adjustable taps on each phase. With these units, you can regularly monitor the voltage balance and make any needed corrections by changing taps. At the other end of the spectrum are sophisticated, computer-controlled devices that monitor and automatically correct voltage and power factor problems.

Industries vary in their use of 3-phase motors. The higher your electric motor usage, the greater the impact unbalanced voltage will have on electric bills. Additionally, if a neighboring plant creates an unbalanced voltage situation, your plant also may experience considerably higher costs related to unbalanced voltage.

Summing up

The cost of unbalanced voltage to U.S. industry may be as much as $28 billion a year. The savings are even more substantial when you consider the value of "uptime" and extended equipment life. Like a leaky faucet, even a small drip can waste hundreds of gallons daily. With voltage unbalance, though, it's not just water but your money that is going down the drain!

Chuck Yung is a technical support specialist at the Electrical Apparatus Service Association (EASA), St. Louis, MO; 314-993-2220; 314-993-1269 (fax); www.easa.com. EASA is an international trade association of more than 2,150 firms in 50 countries that sell and service electrical, electronic, and mechanical apparatus.

Compressed Air System Improvement Project Yields Substantial Energy Savings at a Paper Mill

In 2002, employees at Procter & Gamble's (P&G) paper products mill in Mehoopany, Pennsylvania performed a project that improved the efficiency of the mill's compressed air system. The project was based on recommendations from DOE Allied Partner, Air Science Engineering, and it included the installation and configuration of a sophisticated network controls package with Management Information System (MIS) capability, the addition of system piping, and the installation of a 1,500 hp compressor to satisfy an anticipated increase in production. Once the project was completed, the plant was able to take a 450 hp compressor offline and still maintain the minimum pressure level required to adequately supply its end-use applications. The project saved 7,600,000 kilowatt-hours (kWh) and $304,000 per year in compressed air energy costs and $5,000 in annual maintenance costs for a total of $309,000. With a total project cost of $545,000, the simple payback was 1.75 years.

Proper compressor control is essential for efficient compressed air system operation and peak performance. At P&G's Mehoopany paper products mill, compressors are located in different buildings across the facility. Before the project, plant personnel had to operate all the units because they could not determine when to shut off unneeded compressors or when to delay bringing additional ones online. This configuration made it logical for the Mehoopany mill to acquire a sophisticated compressor control system that could effectively orchestrate the operation of multiple compressors that are spread apart in various locations. The installation of these controls was executed within the context of a system-level strategy to improve system performance. Once the additional action items were implemented, the system was able to match its air supply to its air demand more closely, which led to more efficient compressor operation and considerable energy savings. Moreover, the control system was able to stabilize the pressure level, thereby avoiding the purchase of additional capital equipment. This project and its results are being shared with other P&G sites with similar compressed air systems.

Mill Identifies Energy and Operational Improvements that May Save $9.6 Million Annually

In partnership with the Industrial Technologies Program (ITP), Georgia Pacific (GP) completed a plant-wide assessment (PWA) at its Crossett, AR, facility in 2002 and identified $9.6 million in potential annual savings. The plant thus far has implemented about 30% of the projects identified in the PWA and has captured annual savings of $3.9 million related to energy reductions. During the course of implementing the PWA projects, other savings opportunities came to light and are being considered for implementation. In addition, four other GP plants in the South have replicated some of the projects first identified by the Crossett PWA.

An assessment team conducted a mill-wide energy survey at Georgia-Pacific's Crossett, AR, mill as an update to a previous pinch analysis. Pinch analysis provides a systematic approach for analyzing energy networks to improve the energy performance of industrial

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processes. It uses graphical representations of the energy flows in the process and utility streams to determine the minimum energy consumption that a process should use to meet its specific production requirements.

The team wanted to identify energy conservation measures and operating practice improvements that would increase the mill's overall energy efficiency. Three heat recovery projects were identified that could reduce annual costs by about $4.8 million and annual natural gas use by 1,845,000 million British thermal units (MMBtu). The overall payback period for the heat recovery projects would be less than 1 year. The team also addressed operational improvements during the assessment. Implementation of operations improvements could yield an additional $4.8 million in annual savings, along with 1,500,000 MMBtu in natural gas savings.

ITP cosponsored the assessment through a competitive process. DOE promotes plant-wide energy-efficiency assessments that will lead to improvements in industrial energy efficiency, productivity, and global competitiveness, while reducing waste and environmental emissions. In this case, DOE contributed $100,000 of the total $290,000 assessment cost.

Founded in 1927 as a wholesaler of hardwood lumber, Georgia-Pacific Corporation has become one of the world's leading manufacturers and distributes of packaging, paper, building products, pulp, and related chemicals. Georgia-Pacific is a worldwide company with approximately $30 billion in sales, employing 85,000 people in more than 600 North American locations and in 11 European locations.

Georgia-Pacific Corporation purchased the Cross Lumber Companies in 1962, spending more than $124 million for operations and land holdings in southeast Arkansas. The first paper machines were installed in Georgia-Pacific Cross Paper Operations in 1937. Georgia-Pacific employs 2,700 people in the Crossett area, while Crossett Paper Operations employs 1,650 people. The plant produces more than 650,000 tons of printing paper, board, and tissue products each year. The mill generates 75% of its own power and also has its own treatment system for both incoming and outgoing water. The Crossett complex consists of the paper mill, plywood mill, and chemical plant.

The Crossett mill cooks wood chips in two parallel batch digester lines to produce hardwood and softwood pulp. Each pulp production line includes its own washing plant. Two parallel bleach plants complete the hardwood bleaching; the softwood bleaching is done in a single line. The bleached pulp is mixed prior to entering the paper machines as required for each grade. The mill consists of two paper machines that make lightweight paper such as those used in copy machines, one board machine that makes paper used in lightweight boxes, and five tissue-paper machines.

The pulping liquor is processed through an integrated pre-evaporator and stripper system, followed by an evaporator train, concentrators, and super concentrators. The concentrated black liquor is fed to the single recovery boiler, then to a recausticizing system that produces white liquor for the pulping process. Steam from the recovery boiler is supplemented by steam produced in the power boilers. Two power boilers primarily use wood waste as fuel. Two natural gas-fired boilers back up the power boilers. Three backpressure turbines generate the majority of the mill power and supply process steam.

Assessment Approach

The assessment team performed a plant-wide energy assessment as an update to an earlier pinch study. The assessment's primary objective was to define energy conservation measures and to recommend operating practice improvements to increase the mill's overall energy efficiency. Elements of the assessment included:

- Formulating heat and material balances
- Modeling the mill's energy profile and constraints affecting the profile
- Evaluating the efficiency of generation, purchase, and use of energy
- Characterizing the minimum thermal energy requirement for operation
- Formulating heat recovery projects that could reduce the mill's total thermal energy consumption
- Targeting cogeneration analysis.

The assessment team applied pinch technology and the Showcasing True Energy Potential (S.T.E.P™) methodology developed by American Process Inc. (API) to examine electrical and thermal energy usage, generation, and purchasing.

Georgia Pacific's assessment team used the S.T.E.P. methodology to evaluate the efficiency of in-house steam generation and production processes, and to review the mill's energy purchasing policies. For example, the team identified maximum sustainable capacities and production bottlenecks. Data representing seasonal fuel use and steam production were used to create an energy profile. Use of alternative fuels was explored. The team also conducted walk-downs to identify potential cost and energy savings through improvements in housekeeping (for example, repairing leaks in the steam delivery and compressed air systems; insulation upgrades). The team then made a series of recommendations for operational improvements and low- or non-capital projects that the mill will continue to evaluate for potential implementation.

The energy efficiency study focused on reducing the amount of fuel used to make steam. Overall, the team examined equipment and departmental efficiencies, electrical and thermal benchmarking, housekeeping, process modifications, cogeneration, and process controls in a systematic and integrated approach.

If Georgia-Pacific implemented three proposed heat recovery projects at the Crossett mill, it would reduce natural gas use year-round and reduce purchased wood waste in the summer. Furthermore, during the winter, two power boilers would only operate at a minimum capacity to respond to fluctuations in steam demand. Implementing these projects would yield an annual cost reduction of about $4.8 million and annual natural gas savings of 1,854,000 MMBtu. The overall payback period would be less than 1 year.

Projects involving operational improvements and cogeneration were also addressed during the S.T.E.P study. Operational changes could save an additional $4.8 million annually if natural gas use were reduced. These S.T.E.P projects' savings are more subjective than those from the heat recovery projects. Benchmarking targets and detailed assessments are required before project implementation. Savings and capital costs depend on operational and maintenance policies, and were not calculated as part of the assessment.

Additional cogeneration is not currently considered to be economically attractive, and implementing the heat recovery projects would reduce the opportunities for cogeneration.

The table summarizes the heat recovery and operational improvement projects identified during the assessment.

Project 1: Heat Recovery from Bleach Plant D Effluents

In the current mill configuration, effluents from the bleach plant D-stage washers are directed to the sewer. The effluent streams

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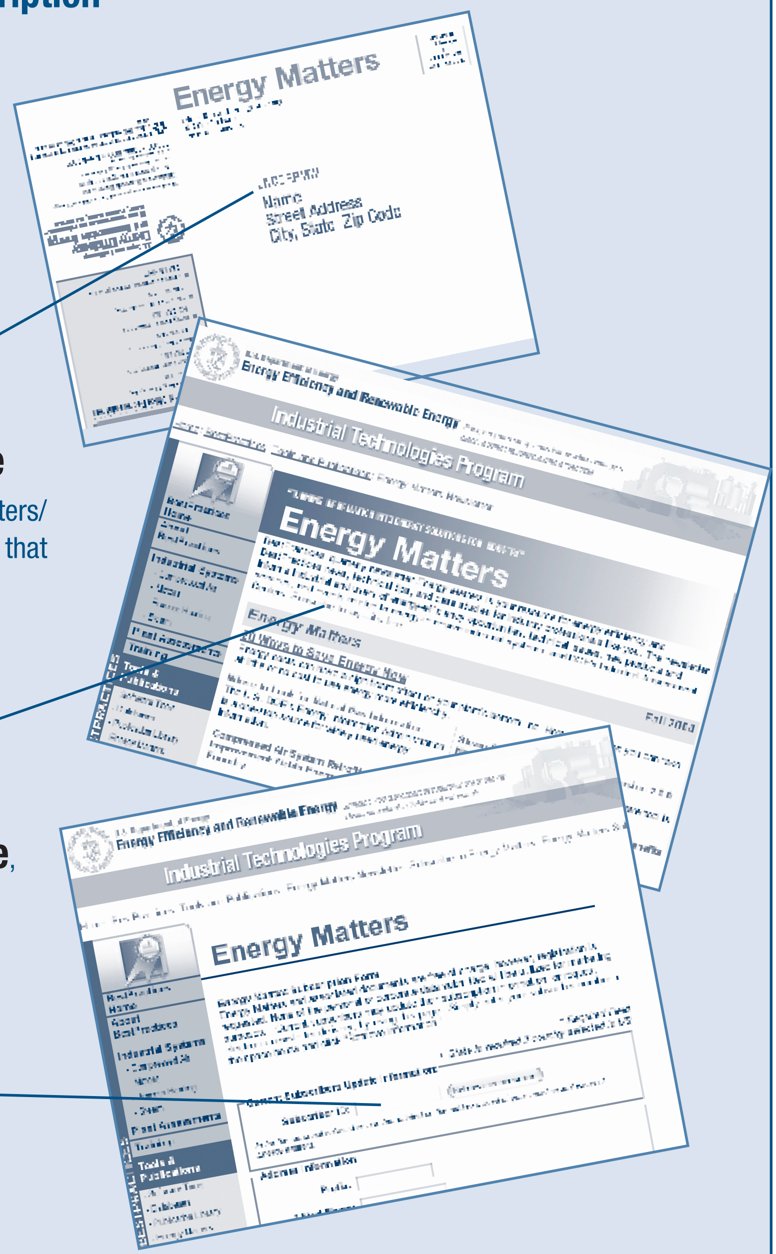

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Projects Identified at the Georgia-Pacific Crossett Mill PWA

	Annual Projected Savings			Annual Projected Economic Impact		
	Fuel (MMBtu)	Steam (MMBtu)	Electricity (kWh)	Annual Savings ($)	Capital Cost ($)	Payback (Years)
Heating Recovery Projects						
Heat recovery from bleach plant D effluents	890,000	665,000		2,400,000	1,600,000*	0.7*
Improved blow heat recovery and demineralized water heating	940,000	705,000		2,350,000	2,250,000*	1.0*
Bleach plant prechiller	15,000	11,000	900	61,400	124,200*	2.0*
Total	**1,845,000**	**1,381,000**	**900**	**4,811,400**	**3,974,200**	
Operational Improvement Projects						
S.T.E.P. Projects	1,500,000	900,000		4,800,000	Not evaluated**	Not evaluated**

*Heat recovery projects will require a detailed cost and engineering analysis before implementation; capital costs are estimates only.
**The study did not evaluate implementation strategies and costs; therefore, the payback period has not been determined.

contain a large amount of heat that is being wasted. This project proposes to install a new heat exchanger to capture this heat and generate warm water for the paper machines. Using this warm water on the machines will reduce the amount of steam required to heat the white water.

Project 2: Improved Blow Heat Recovery and Demineralized Water Heating

The blow heat recovery system captures the heat from the flash steam generated when a digester is emptied from approximately 100 pounds per square inch gauge (PSIG) to an atmospheric storage tank. The flash steam is condensed, and an accumulator stores the condensate. From the accumulator, the condensate is routed through a series of heat exchangers, where it is cooled and returned to the bottom of the accumulator. With the current configuration, a cooling tower removes excess heat from the accumulator and a steam heater generates hot water for the bleach plant. This project's purpose is to improve the heat recovery in the blow-heat area of the pulp mill and E-stage bleaching effluent for demineralized water heating. By installing new heat exchangers and rerouting some water lines, the cooling tower can be shut down and the steam heater removed. Steam reduction would lead to cost savings.

Project 3: Bleach Plant Prechiller

The mill continuously operates two chillers to provide cold water for the chlorine dioxide (ClO_2) plant. The chillers take well water that is a constant 70°F all year and chill it to around 45°F. The proposed prechiller would utilize 50°F ClO_2 solution from the ClO_2 plant to cool the incoming well water. This will not only reduce electrical energy demand from the chillers, but will also preheat the ClO_2 solution going to the bleach plant and reduce the amount of steam needed for heating.

The assessment team also addressed operational improvements and cogeneration opportunities. The mill would save on operating costs by improving mill operational parameters, housekeeping, and purchasing strategies. Cogeneration opportunities include those resulting from noncapital operational changes and a possible turbine upgrade. Because they are currently considered to be economically infeasible, the team did not estimate capital costs for cogeneration projects. Implementing all the heat recovery projects would also decrease the opportunities for cogeneration capacity. Implementing all heat recovery projects and operational improvements together may not be feasible and may require additional expenditures and analysis.

Operational Improvements

The assessment team studied various operational improvements to increase energy efficiency and energy conservation. The quantified items included improved boiler oxygen control, tank insulation, condensate recovery, steam and compressed air leak repair, and a more efficient black liquor evaporation scheme.

Process changes include increasing the high-pressure steam header pressure and reducing low- and medium-pressure header pressures. The savings would be obtained by reduced natural gas and steam usage.

Specific projects and their potential annual savings included:

- Reduce and control power boiler excess oxygen to save 66,000 cubic feet per hour (ft^3/hr) of natural gas ($2 million)
- Insulate five large storage tanks to save 25,000 pounds per hour (lb/h) of steam ($661,500)
- Repair steam leaks that had existed more than 1 year to save 7,700 lb/h ($263,000)
- Shift more black liquor evaporation to the 6-effect train to save 30,000 lb/h ($793,000)
- Improve condensate collection by repairing leaks and improving collection coverage to 65% and save 40,000 lb/h ($1,058,400)
- Clean heat exchangers (the savings have not been calculated but are believed to be significant).

Additional cogeneration opportunities include optimizing turbine pressure levels, improving steam turbine efficiency, and lower steam level for the users. The savings would come from incremental electricity cogeneration; however, there would be a penalty for additional fuel required.

To learn more about the plant-wide assessment program, visit the plant-wide assessment Web page at http://www.oit.doe.gov/bestpractices/assessments.shtml or contact the EERE Information Center at 1-877-EERE-INF (1-877-337-3463).

Berkeley Lab Finds Industrial Energy Efficiency Strategies Can Help Ease Natural Gas Prices

Energy costs can have a significant effect on your plant's bottom line. Volatile natural gas prices in the recent past have made it even more important that energy be used efficiently and effectively.

Researchers working at the Ernest Orlando Lawrence Berkeley National Laboratory recently completed a study that finds increased investment in energy efficiency, among other strategies, could help ease the threat of high natural gas prices over both the short and the long term.

The report demonstrates that energy efficiency and renewable energy can displace gas-fired electricity generation, reducing gas demand and putting downward pressure on natural gas prices and bills for consumers, including manufacturers. The simplified method may be applied to the impact of industrial energy efficiency on gas prices and bills.

Based in large part on a review of other modeling studies, the report is among the first to demonstrate that these results are broadly consistent with economic theory, results from other national energy models, and limited empirical evidence.

The report, "Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency", was published by the national laboratory in January.

The report reviews existing modeling studies and finds that these generally show that each 1% reduction in natural gas demand nationwide is likely to lead to a long-term wellhead price reduction of 0.8% to 2%. Some studies show more significant reductions, the authors report.

The report also demonstrates the use of an analysis tool that can evaluate the potential effect energy efficiency and renewable energy strategies may have on natural gas prices and bills. The analytical tool is fueled by eight pieces of data. These are:

- Level of increased energy efficiency or renewable energy: This represents (in megawatt-hours—MWh) the incremental amount of energy efficiency and renewable energy advocated by various policymakers relative to a baseline "business-as-usual" scenario.
- Natural gas displacement ratio: This represents the share of natural gas generation displaced by energy efficiency or renewable energy. Displacement ratios evaluated by the report average between 34% and 78%. The authors recommend using a gas displacement ratio of 40%.
- Natural gas heat rate: This converts the amount of displaced natural gas generation (in MWh) to an amount of displaced natural gas consumption (in millions of British thermal units—MMBtu). The authors recommend using a near-term heat rate of 9,000 Btu/kWh. They estimate that heat rates should drop to around 7,500 Btu/kWh over the next five years.
- Total expected natural gas consumption: Estimates may be obtained from the latest Energy Information Administration (EIA) Annual Energy Outlook.
- Inverse price elasticity of supply: Converts the percentage reduction in U.S. gas consumption into a percentage reduction in the national average wellhead price. The authors recommend a range of 0.8 to 2 for this highly uncertain variable, with a "conservative" base-case value of 1.2.
- Business-as-usual wellhead gas price forecast: Forecasts may be obtained from the latest EIA Annual Energy Outlook.
- Delivered price conversion: The authors contend it is reasonable to assume that a $/MMBtu reduction in national wellhead prices will translate one-for-one into similar reductions in the national average delivered natural gas price, both to the electricity sector and to end users such as manufacturers.
- Regional multipliers: These estimate the differential effects of regional energy efficiency and renewable energy policy cases and vary by region and with time. The analysis uses the National Energy Modeling System, but the authors advocate further research on regional impacts to arrive at even more reliable multipliers.

Using these inputs to consider the potential national impact of energy efficiency and renewable energy strategies, the authors find that the "likely" national gas-bill savings from energy efficiency and renewable energy strategies ranges from about $5/MWh (assuming 20% gas displacement and an inverse elasticity of 0.8) to about $45/MWh (assuming 80% gas displacement and an inverse elasticity of 2.0). Even at the low end of this range ($5 to $20/Mwh) the authors conclude that the incremental benefits are substantial.

BestPractices, a program of the Industrial Technologies Program, works with industry to identify plant-wide opportunities for energy savings and process efficiency. Through the implementation of new technologies and systems improvements, companies across the U.S. are achieving immediate savings results. Visit http://www.oit.doe.gov/bestpractices/ for more information.

Watch for Fan System Qualified Specialist Training Opportunities

The Fan System Assessment Tool (FSAT) is the latest in the suite of DOE-developed software tools. With FSAT you can calculate the amount of energy your fan system uses, determine fan system efficiency, and quantify the savings potential of an upgraded fan system.

The Industrial Technologies Program also offers Fan System Assessment Training, a 1-day workshop highlighting the benefits of optimizing fan systems and examining fan system performance characteristics. If you are a plant engineer or are involved in operating and maintaining your plant's fan systems, consider attending one of these training sessions. The training helps you determine the cost of operating fans in your facility, understand the interaction between the fan curve and the system curve, analyze the optimization potential of fan systems, and create an action plan to improve fan system efficiency and reliability in your plant.

Also watch for Fan System Qualified Specialist Training coming to your area starting this spring. DOE is developing an additional level of training for industry professionals interested in becoming Qualified Fan System Specialists. By successfully completing this advanced training you will be recognized by DOE as a Specialist in the use of FSAT. As a Specialist, you can then apply the tool to help your plant or industrial customers identify ways to improve fan system efficiency.

The pilot for this specialist training will take place in Arlington Heights, Illinois, April 12-14, and is limited to individuals with fan system expertise. For more information on this session, contact Bill Gentes at bgentes@amca.org , or 847-394-0150.

To learn about upcoming Fan System Assessment training in your area, visit the BestPractices training calendar. Or, contact the EERE Information Center at 1-877-EERE-INF (1-877-337-3463), or http://www.eere.energy.gov/informationcenter.

Coming Events

This list represents only 11 of the 38 training opportunities that are available to you. For a complete listing, registration information, and updates, visit the BestPractices training web site at http://www.oit.doe.gov/bestpractices/training/textCalendar.shtml.

Steam System Assessment, Center Valley, PA, Mar 23, 2005
For more information, contact David Althoff at dalthoff@state.pa.us or 717-705-0372

Pumping System Assessment, Stockton, CA, Apr 05, 2005
For more information, contact Cheryl Boswell-Barnes at cjb9@pge.com or 209-932-2529

Fan System Assessment, Austin, TX, Apr 05, 2005
For more information, contact Kathey Ferland kferland@mail.utexas.edu or 512-232-4823

Process Heating Assessment, Upper Darby, PA, Apr 06, 2005
For more information, contact Michael Sanders at mpsanders@sunocoinc.com or 215-339-7111

Pumping System Assessment, Campbell, CA, Apr 06, 2005
For more information, contact Cheryl Boswell-Barnes at cjb9@pge.com or 209-932-2529

Fundamentals of Compressed Air Systems (Level 1), Baltimore, MD, Apr 07, 2005
For more information, contact Brandon Arnold at barnold@energy.state.md.us or 410-260-7206

Process Heating Assessment, Tulare, CA, Apr 07, 2005
For more information, contact Gary Pikop at pikopgj@sce.com or 559-625-7127

Fan Systems Specialist Qualification, Arlington Heights, IL, Apr 12-14, 2005
For more information, contact Bill Gentes at bgentes@amca.org or 847-394-0150

Steam System Assessment, Stockton, CA, Apr 12, 2005
For more information, contact Cheryl Boswell-Barnes at cjb9@pge.com or 209-932-2529

Advanced Management of Compressed Air Systems, Burlington, VT, Apr 19-20, 2005
For more information, contact Danielle McMahon at DMcMahon@veic.org or 802-860-4095, Ext. 1043

Steam System Specialist Qualification, Milwaukee, WI, Apr 25-27, 2005
For more information, contact Tony Wright at wrightal@ornl.gov or 865-574-6678

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