Motor Incentives for Drillers | Refinery Saves $500,000 | Gas Compressors

February 2010

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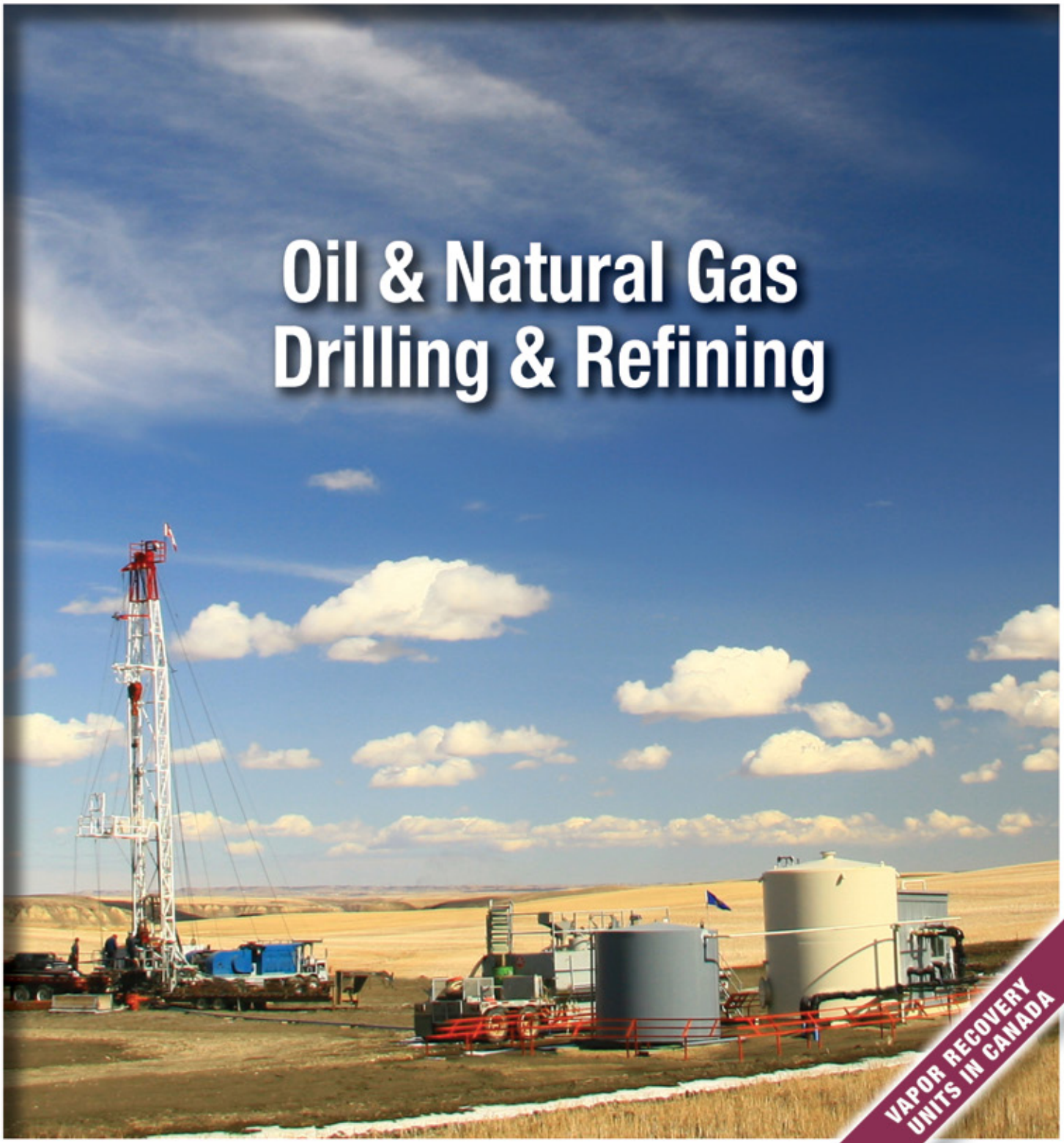

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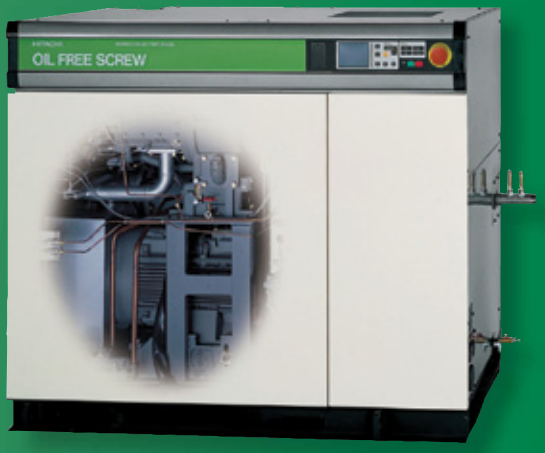

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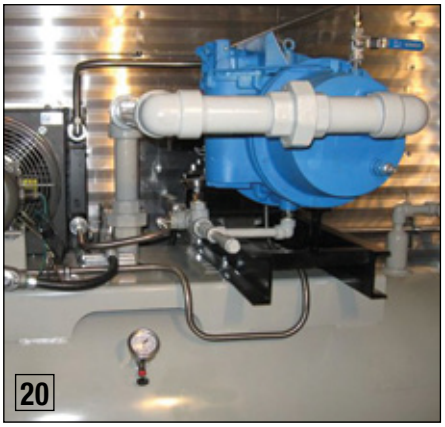
SUSTAINABLE MANUFACTURING FEATURES



COLUMNS

FROM THE EDITOR

Oil and Natural Gas Drilling and Refining

Oil and natural gas exploration and refining companies are, to me, a fascinating industry. They tend to be vilified by the media as destroyers of the environment. I personally am glad I can heat my home and drive my car. There's no question, however, that investments must be made by energy companies to reduce their emissions. The practice of "gas flaring", for example, has been shown to be a tremendous contributor to the problems with greenhouse gases. In this edition, Northwest Equipment, from Alberta, Canada, shares with us how Vapor Recovery Units (using blower and air compressor packages) are providing the carbon-zero alternative to gas flaring.

Hank Van Ormer shares with us a demand-side and supply-side assessment of a major oil refinery. The facility was able to reduce their rental diesel air compressor bills by over $440,000 per year! With four clear-cut action items, the facility was also able to reduce demand for compressed air, and take advantage of 800 scfm of "free" compressed air generated by a steam-driven centrifugal air compressor.

Hycomp, Inc. shares with us an article on how they design their gas compressors to withstand the rigorous applications where they are deployed. Using "large designs on small compressors" and customizing each product to meet the application, has enabled this company to find a niche where it can grow and prosper.

Southern California Edison's Rod Vickers shares a story of the work he has done with a major oil field that deploys water-injection oil recovery systems. SCE was able to help the drilling company review the motor efficiencies of their pumps and offered incentives to encourage the company to upgrade to more efficient pump motors.

When I think of refineries, I think of piping systems. In this edition, the Compressed Air Challenge® provides guidance on "Understanding Pressure Drop" in distribution piping. This continues to be a great energy-efficiency opportunity for all large-scale operations.

We hope you enjoy this edition, and thank you again for your support and for investing in industrial energy efficiency. BP

ROD SMITH
Editor
rod@airbestpractices.com

Vapor Recovery Units provide the carbon-zero alternative to gas flaring.

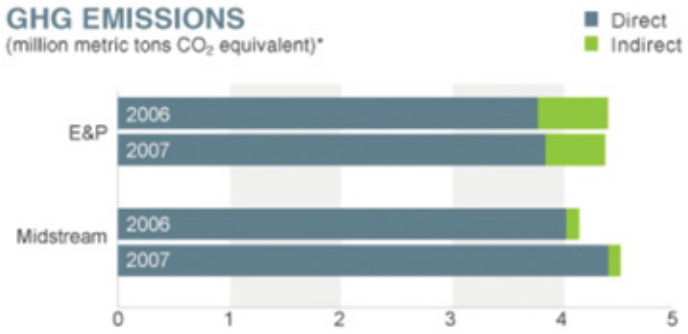
SUSTAINABLE MANUFACTURING NEWS

Anadarko, ConocoPhillips, Connacher, ExxonMobil

SOURCED FROM THE WEB

Anadarko's Commitment

At Anadarko, we are keenly aware that greenhouse gas (GHG) emissions — particularly carbon dioxide (CO_2) and methane (CH_4) — have emerged as a specific concern. We continually look for innovative ways to minimize the overall environmental impact of our activities, including reducing GHG emissions. We are a Production and Processing Partner in the United States Environmental Protection Agency's Natural Gas STAR Program, a founding member of The Climate Registry, a founding member of the American Carbon Registry and a participating member of the American Petroleum Institute's Climate Challenge Program and Business Roundtable's Climate RESOLVE Program.



* Calendary year (CY) GHG Emission estimates reported only for Anadarko-operated facilities. Anadarko uses the SANGEA Emissions Estimation System to calaculate emissions of GHG from our operations.

Source: www.anadarko.com

Examples of our efforts include:

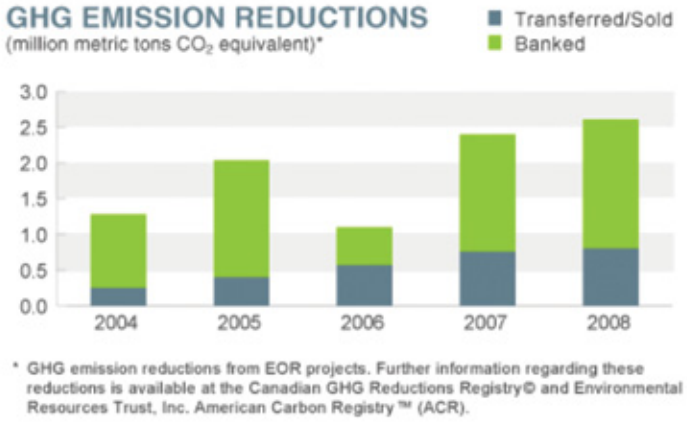
- Working to minimize the flaring and venting of methane to increase energy efficiency and reduce emissions
- Anadarko's enhanced oil recovery (EOR) operations in Wyoming utilize CO_2 to stimulate oil production. The CO_2 injected into the ground enhances domestic oil production and prevents GHG from being emitted into the atmosphere. The project currently sequesters enough CO_2 each day to offset the equivalent emissions of more than a half million cars
- As a result of our CO_2 sequestration activities in Wyoming, we have created a surplus of registered and verifiable CO_2 emissions reductions. These efforts, combined with growing awareness of the benefits of EOR-related geologic sequestration, have given Anadarko encouragement about potential future growth in voluntary environmental markets

"We continually look for innovative ways to minimize the overall environmental impact of our activities, including reducing GHG emissions."

— Anadarko

In 2004, the company approved a GHG management plan, recommended by the company's Climate Change Committee. The plan addresses the management of emissions of CO_2 and CH_4 at all of Anadarko's worldwide operating locations. In our view, it's possible to achieve reductions in GHG emissions in a cost-effective and voluntary manner.

Anadarko continues to inventory and assess its corporate-wide GHG emissions inventory baseline and GHG intensity by utilizing our established and updated Corporate GHG Protocol. We also continue to calculate, third-party verify and register our GHG emissions reductions from our EOR projects. Our methodology is consistent with established industry guidelines found in the IPIECA/API/OGP Petroleum Industry Guidelines for Reporting GHG Emissions and standards set by the World Business Council for Sustainable Development and the World Resource Institute.



Source: www.anadarko.com

SUSTAINABLE MANUFACTURING NEWS

Anadarko, ConocoPhillips, Connacher, ExxonMobil

"In ventures where we are not the operator or hold a minority interest, we strive to influence our partners to implement similar programs."

— ConocoPhilips

ConocoPhillips' Energy Efficiency Approach

Refining Efficiency

ConocoPhillips continually strives to improve the energy efficiency of our refineries. This accomplishes three goals:

1. Reducing our energy consumption in the form of electricity, natural gas, refinery gas and steam
2. Improving the GHG impact of our operations
3. Reducing our operating costs

We are performing energy-efficiency reviews at our refineries to identify opportunities to reduce energy consumption. Indeed, this is a vital goal that is considered in conjunction with such operational objectives as expanding processing and clean-fuels production capacities, and improving ability to refine more difficult grades of crude oil. In ventures where we are not the operator or hold a minority interest, we strive to influence our partners to implement similar programs.

For example, certain heater-replacement projects allow more efficient operations and improve energy efficiency. These include our Borger, Texas, refinery's gasoline benzene reduction project, and the major expansion and heavy-oil processing project at our Wood River refinery in Roxanna, Ill., which will incorporate more efficient process heaters and modern heat recovery.

Significant energy-efficiency improvements were realized through several projects in 2008:

- Los Angeles Refinery — Coker unit fractionation improvements
- Ponca City Refinery — New furnace with better energy efficiency
- Trainer Refinery — Two new boilers replaced older, less-efficient units
- Flare Gas Recovery Projects at Multiple Refineries — Recapturing waste gases for refinery use, reducing flaring and thus improving energy efficiency

Additionally, during 2008, the Billings, MT refinery received its second consecutive EPA ENERGY STAR® for superior energy efficiency based on the Energy Intensity Index®, as defined by Solomon Associates, an industry consultant specializing in comparative performance analysis. This analysis placed the refinery in the top quartile of energy efficiency for similarly sized facilities. Our Lake Charles refinery in Westlake, La., also received the ENERGY STAR® in mid-2007.

Upstream Efficiency

The company's Exploration and Production business unit conducted a number of projects to improve overall energy efficiency in its producing fields. Among them, the Ekofisk II redevelopment project in the North Sea utilized high-efficiency turbines to reduce power usage and recover waste heat produced during power generation.

The C-GAS project, undertaken by Conoco Phillips China, replaced diesel fuel with excess associated gas to fuel the turbine generator during the early operational years. This project achieved greater efficiency, reduced flare volumes and reduced diesel fuel consumption.

In Indonesia, our Suban natural gas processing plant optimized power generation by implementing a load sharing and fuel-usage monitoring system.

In 2008, the Canada business unit completed more than 160 projects, saving approximately 7.9 million cubic meters of natural gas. This also precluded approximately 31,000 metric tons of CO_2 emissions, equivalent to taking 5,900 cars off the road. Projects included installing solar-powered chemical injection units, upgrading burners, optimizing our operations to allow some facilities and equipment to be shut down, capturing vented gas and identifying and eliminating fugitive emissions at our facilities. The energy efficiency team is committed to completing eight large and 80 small projects in 2009 to evaluate and test technologies that will reduce our emissions footprint. The results of these efforts and ideas for future projects will be tracked and recorded.

The U.S. Lower 48 business unit improved energy efficiency through greater utilization of photovoltaic solar panels on field equipment. For example, we are installing solar-powered chemical injection units in place of gas-powered pumps on wells, thus reducing emissions and fuel use.

Source: www.conocophillips.com

ConocoPhillips

SUSTAINABLE MANUFACTURING NEWS

Anadarko, ConocoPhillips, Connacher, ExxonMobil

> "Connacher actively pursues a number of initiatives to reduce the overall physical footprint of our facilities and activities, including the use of low-impact seismic and reusing existing lines. In 2010, Connacher has committed over $700,000 for our footprint-reduction initiatives."
>
> — Connacher

Connacher Manages Emissions

In-situ facilities in the Alberta oil sands, like Connacher's at Pod One and Algar, have a footprint similar to conventional oil and gas operations. We use steam-assisted gravity drainage (SAGD) to remove oil in the form of bitumen from deep underground.

- SAGD uses approximately 85–90% less surface area than mining operations
- SAGD does not incorporate tailings ponds

Connacher actively pursues a number of initiatives to reduce the overall physical footprint of our facilities and activities, including the use of low-impact seismic and reusing existing lines. In 2010, Connacher has committed over $700,000 for our footprint-reduction initiatives.

Air Emissions

As an in-situ oil sands producer, Connacher is committed to managing air emissions through an integrated corporate approach, which considers opportunities to reduce both air pollutants and greenhouse gases. By 2015, Connacher anticipates reducing its carbon footprint of bitumen to less than or equal to that of conventional oil and gas.

Natural gas used in the SAGD process is a clean-burning fuel that generates far less NOx and other contaminants than other sources do. Nonetheless, we have implemented a comprehensive program designed to reduce or eliminate certain emissions. This includes a leak assessment tool to track, repair and test fugitive emissions; the management of emissions to comply with regulated allowances; and, emissions credits, offsets and associated financial compliance obligations and opportunities.

Air quality programs continue to be an essential part of Connacher's environmental business plan. Emerging technologies continue to have a positive effect on reducing environmental impact, and Connacher has invested in these innovations. Connacher has committed funding for the construction of a $30 million co-generation facility at Algar, which will enable us to self-supply our power requirements, reducing electricity demand on Alberta's coal-fired power grid and generating heat that can be used in the SAGD process. Additionally, the use of electric submersible pumps has reduced our steam:oil ratio (SOR) and contributed favorably to reducing our emissions footprint.

Source: www.connacheroil.com

Energy Efficiency Improvements at ExxonMobil

In 2008, our operations consumed approximately 1.5 billion gigajoules of energy. By applying new energy-efficient technologies, we use less energy to run our business, extend the life of the world's energy reserves and reduce GHG emissions. Since 2004, we have invested more than $1.5 billion in activities to increase energy efficiency and reduce GHG emissions. In the next few years, we plan to spend at least $500 million on additional energy efficiency initiatives.

In 2008, our energy efficiency performance in our refining and chemical operations was about even versus 2007, largely due to changes in plant operations. However, over the past several years, we have improved at a rate that is about two to three times faster than what is typical in the industry. We remain on track to meet our target of improving energy efficiency across our worldwide refining and chemical operations by 10% between 2002 and 2012. This target is consistent with the American Petroleum Institute's Voluntary Climate Challenge Program in the United States.

Reductions in CO_2 Equivalents

Over the last seven years we have achieved real sustainable reductions of 7.5 million tons of CO_2 equivalent ($MteCO_2e$). In 2008, we reported $0.4MteCO_2e$ of reductions, including, for example, expansion of the use of "smart" well automation to reduce venting and improved well completion procedures to reduce flaring at our Wamsutter natural gas operations in the U.S., which resulted in emissions being $48{,}000teCO_2e$ lower than they would have otherwise been. BP

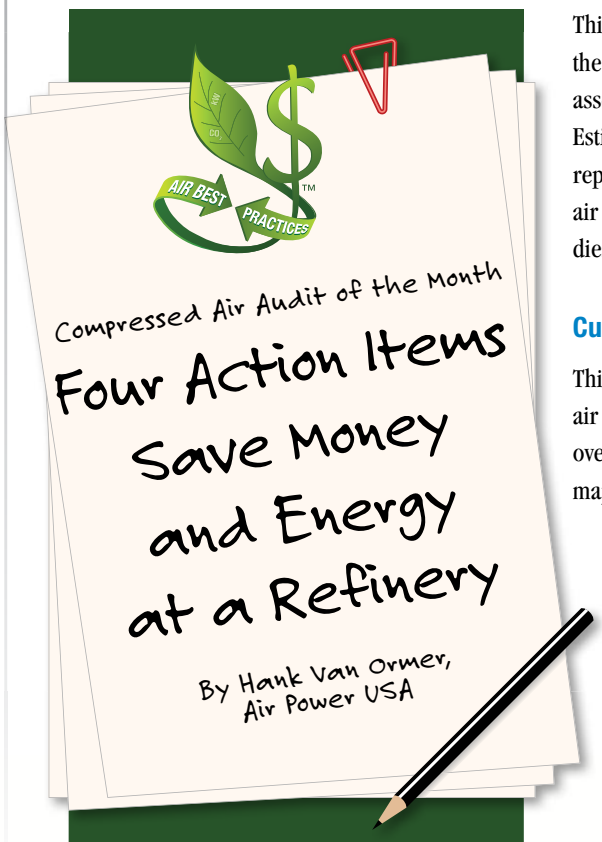
Source: www.exxonmobil.com

ExxonMobil

THE SYSTEM ASSESSMENT OF THE MONTH

Four Action Items Save Money and Energy at a Refinery

BY HANK VAN ORMER, AIR POWER USA



January Audit of the Month

Where: United States
Industry: Oil Refinery
Issues: Rental Compressors, End Uses
Audit Type: Supply and Demand Side

System Assessment Win/Win Results*

Reduction in Compressed Air Use: 1,532 scfm
Approximate Annual Energy Savings: $382,355
Investment: $134,400
Simple ROI: 2.84 months
Savings on Rental Compressors: $441,544

*Annual energy consumption

This refinery currently spends $735,757 annually on the electricity required to operate the compressed air system at its plant. The group of projects recommended in the system assessment will reduce these energy costs by an estimated $364,211 (49% of current use). Estimated costs for completing the recommended projects total $435,800. This figure represents a simple payback period of 14.4 months. The firm also reduced compressed air demand by 732 scfm allowing them to save $441,544 by down-sizing the back-up rental diesel air compressors.

Current System Description

This is an old refinery that has been modified many times over the years. There are multiple air compressor and air treatment systems all over the facility. As the system demands increased over the years, satellite compressors and heated desiccant dryers were added throughout the major production areas.

- The original power house had a large Clark Natural Gas Angle engine/ compressor and a mix of Worthington, four-point mounted, two-stage, double-acting, horizontal reciprocating units. About ten years ago, a 3,200 scfm, steam turbine-driven, centrifugal air compressor was added, along with a steam-regenerative, 3,500 scfm blower purge desiccant air dryer. The reciprocating units have been taken out of service due to very high maintenance costs and obsolescence of their major parts
- Other production areas have a mix of lubricant cooled, single-stage rotary-screw air compressors. Many types of heated and heatless desiccant air dryers treat the air. One production area located across the street from the main power house, which is slated for demand-growth, has contaminated ambient air
- Six or more diesel-driven rental units have been brought in as back up for various production areas (and the main power plant) on a continuing basis, with a minimum rental and diesel fuel cost of $883,000 per year. The plant also incurs a cost to install and maintain the large diesel engines, which require oil and filter changes every 150–200 hours of operation. We conservatively estimate this total cost at $50,000 per year

This was a supply- and demand-side audit. Due to article length limitations, we will outline only the actions taken to reduce the costs associated with the rental air compressors, and we will outline actions taken to reduce compressed air consumption. The supply-side was reconfigured with new, more efficient air compressors with controls capable of capitalizing on the reductions in air demand — but that's another story.

January Audit of the Month

Compressor System Before Assessment

Operating Hours:	8,760 hours
Power Cost kW/h:	$0.12
Avg. Air Flow:	6,696 scfm
Electric Cost per Unit of Air:	$250.09 per scfm per year
Annual Compressor Energy Cost:	$791,514
Annual Rental Compressor Cost:	$883,088

Compressor System After Assessment

Operating Hours:	8,760 hours
Power Cost kW/h:	$0.12
Avg. Air Flow:	5,164 scfm
Electric Cost per Unit of Air:	$164.74 per scfm per year
Annual Compressor Energy Cost:	$409,159
Annual Rental Compressor Cost:	$441,544

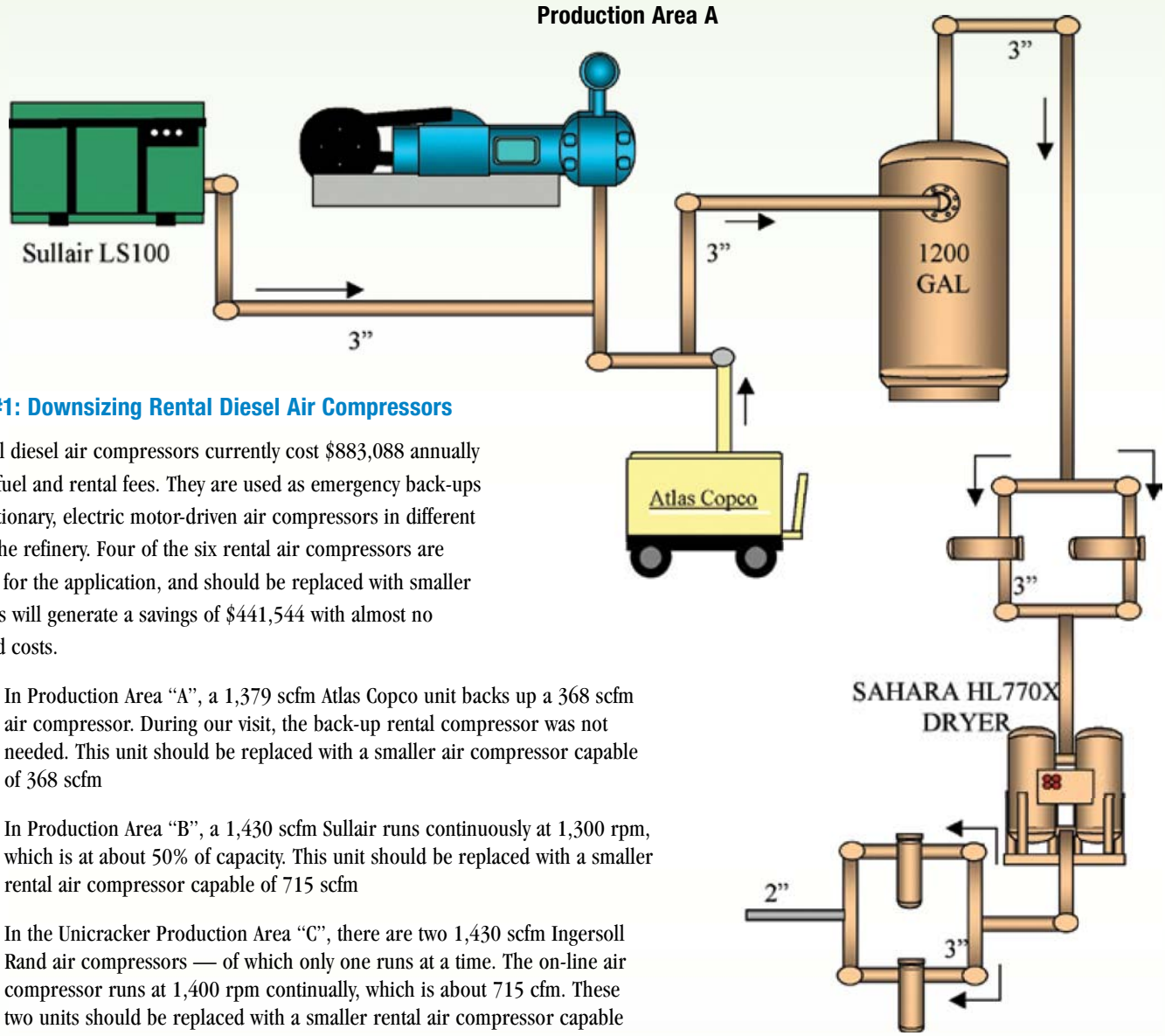
Measurement Actions Taken

The following actions were taken to establish baseline measures for flow and pressure:

1. Temperature readings were obtained on all units using an infrared surface pyrometer. These were observed and recorded to correlate to the unit's performance, load conditions and integrity.
2. Flow was calculated by observing the mechanical action of the unloader control on the Sullair unit — the engine rpm and inlet valve action on the diesel engine drive, and the mechanical action of the inlet butterfly valve and the blow-off valves on the Elliott centrifugal.
3. Pressure readings were taken throughout the plants with the same Ashcroft test gauge used in No. 2 above.
4. Discussions were held in detail with the appropriate operators in various units.

THE SYSTEM ASSESSMENT OF THE MONTH

Four Action Items Save Money and Energy at a Refinery



Action #1: Downsizing Rental Diesel Air Compressors

The rental diesel air compressors currently cost $883,088 annually in diesel fuel and rental fees. They are used as emergency back-ups to the stationary, electric motor-driven air compressors in different areas of the refinery. Four of the six rental air compressors are oversized for the application, and should be replaced with smaller units. This will generate a savings of $441,544 with almost no associated costs.

- In Production Area "A", a 1,379 scfm Atlas Copco unit backs up a 368 scfm air compressor. During our visit, the back-up rental compressor was not needed. This unit should be replaced with a smaller air compressor capable of 368 scfm
- In Production Area "B", a 1,430 scfm Sullair runs continuously at 1,300 rpm, which is at about 50% of capacity. This unit should be replaced with a smaller rental air compressor capable of 715 scfm
- In the Unicracker Production Area "C", there are two 1,430 scfm Ingersoll Rand air compressors — of which only one runs at a time. The on-line air compressor runs at 1,400 rpm continually, which is about 715 cfm. These two units should be replaced with a smaller rental air compressor capable of 715 scfm

Action #2: Piping Changes in the Power House

There are two piping changes required in the main power house.

Piping Change #1:

The two 1600 scfm diesel air compressors, backing up the Elliott centrifugal in the main plant air power house, are correctly sized. There are, however, two piping issues here. The current connection of the Sullair and IR units to back up the Elliott will preclude both of these units from reaching full load. The air line from the IR is connected to a 3-inch diameter spool piece about eight feet long. The Sullair connects with a 90° tee entry right at the front of the spool piece (see image). The high degree of turbulence-driven backpressure will force both units to prematurely unload, not allowing full flow into the plant at acceptable pressures.

Changing this spool piece to a 6-inch diameter pipe and connecting the Sullair with a mid-mounted 30°–45° angle directional entry (see image on the next page) will eliminate this problem. Consider adding additional directional angle entries to the new spool piece for other compressors, when required. Note: The connection from the 4-inch hose and Sullair 1600H is through a 2-inch line to the piping trough. This is probably also building up some backpressure. Since this unit is apparently only putting about 715–725 scfm into the system, it could be changed out for a smaller 750 scfm to 825 cfm unit. The 2-inch line will not then be such a problem, but probably should be changed to 3- or 4-inch.

These piping modifications will enable these two units to fully "load in" and deliver their 2,860 scfm to back up the 3,200 cfm Elliott centrifugal. Without this change, we would not expect more than 1,200–1,400 scfm to flow freely at 115 psig, and **additional units would have to run** to hold pressure.

Piping Change #2:

The most energy-efficient air compressor in the system is the steam-driven Elliott 3-stage centrifugal air compressor. Steam is at 600 psig let down, and is considered "free" at the refinery as it is reduced from 600 psig to a usable 150 psig for other processes by running the turbine. The Elliott compressor delivers 3,200 scfm at 135 psig @ 594.4 kW (electric version) with a specific power of 5.38 scfm/kW specific power (if electric driven). This efficiency, with the low cost of 600–150 psig let down steam power, makes it a very low-cost operating energy unit.

The Elliott compressor cannot reach full flow but stays in blow off because of too small a service line to main production area across the street.

The piping change requires connecting the existing (but abandoned) 6-inch phenolic line at the plant air compressor room header. This line runs across the street to a production area that is experiencing demand growth. This area across the street, however, has a contaminated ambient environment. For this reason and due to the "free steam", we recommend reconnecting this phenolic line. This will also allow the Elliott to fully load in and supply a continuing 3,200 scfm instead of only the 2,400 scfm it does now. This will supply an extra 800 scfm at a very favorable efficiency, which means **free steam power**!

Even at the new, reconfigured, more efficient electric-driven compressed air system, this will save 800 scfm @ $250.09 cfm/yr ($200,072 per year). The estimated one-time cost to do this is $50,000.

Action #3: Compressed Air Leak Survey Saves 451 scfm

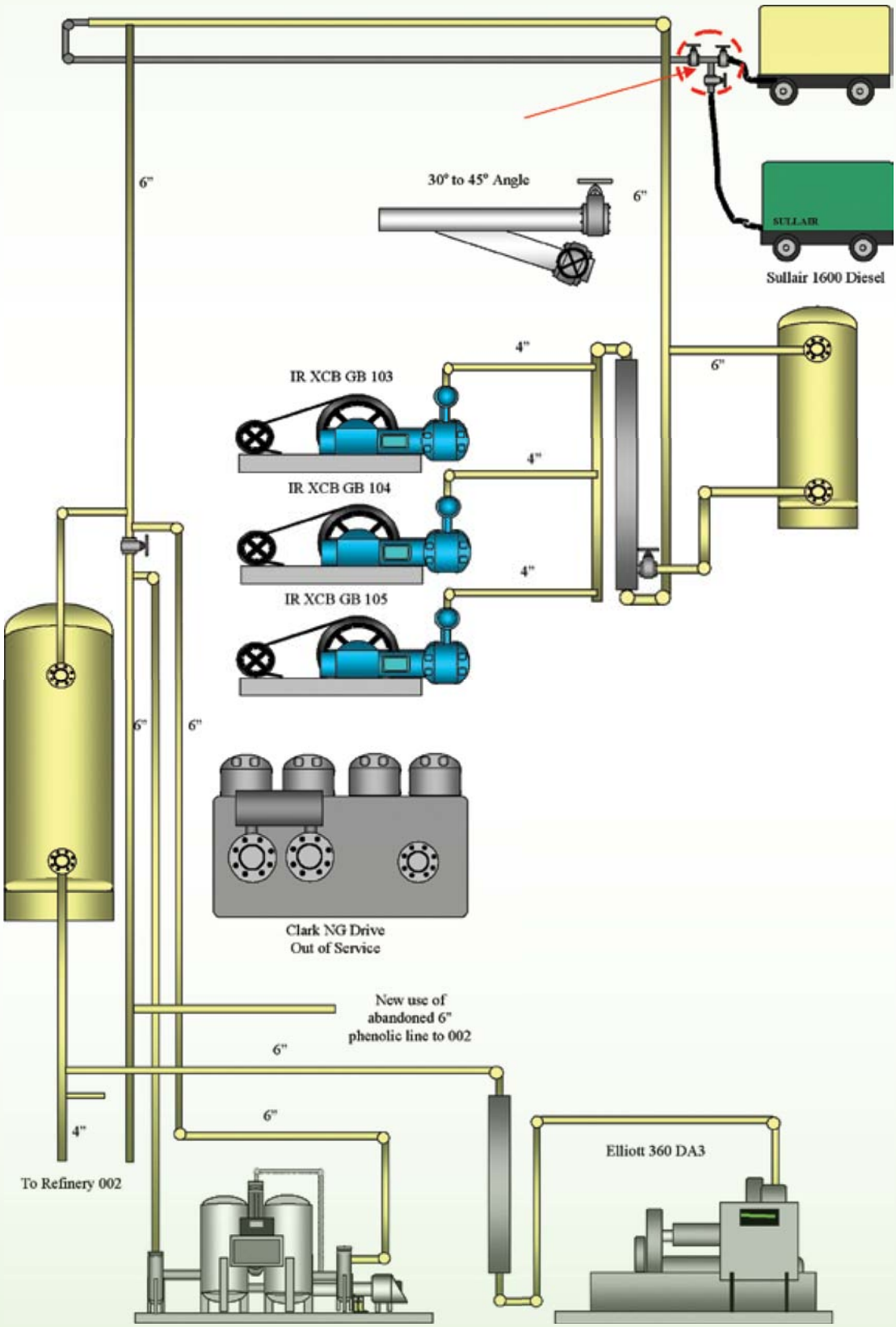
A survey of compressed air leaks was conducted at the plant, and 115 leaks were identified, quantified, tagged and logged. For the 115 leaks identified, potential savings totaled 451 cfm.

Leaks were located in many areas. The largest, totaling 100 scfm, was actually a series of leaks located in the truck transporter. A three-inch pump had a 10 scfm leak, and there were multiple 5 scfm leaks located at filters, lubricators, valves and hose reels.

THE SYSTEM ASSESSMENT OF THE MONTH

Four Action Items Save Money and Energy at a Refinery

Plant Air Power House: Planned and Suggested Changes



Shutting off the air supply to these leaks when the area is idle would save significant energy. When the air to the machine cannot be shut off, simply reducing the overall system pressure would also reduce the impact of the leaks. Repairing the leaks is another opportunity to save additional energy. The savings estimates associated with a leak management program are based on the unloading controls of the compressors effectively translating reduced airflow into lower costs.

With a few minor exceptions, most of the leaks could not have been found without the use of an ultrasonic leak detector and a trained operator. Leak locating during production time with the proper equipment is very effective, and often shows leaks that are not present when equipment is idle. However, a regular program of inspecting the systems in "off hours" with "air powered up" is also a good idea. In a system such as this one, some 90–95% of the total leaks will be in the use of the machinery, not in the distribution system.

The area surveyed in the leak study included a great deal of high background ultrasound noise that shields many of the smaller leaks. In continuing the leak management program, plant staff should perform leak detection during non-production hours in order to eliminate some of the high ultrasonic background noise.

Estimated reduction of air flow with proposed project:	451 cfm
Recoverable savings from air flow reduction:	$250.09 /cfm yr
Annual electric cost savings with proposed project:	$112,795 per year
Cost of leak detection equipment (if required):	$2,800
Unit cost of leak repairs ($15 materials and $35 labor per leak):	$5,750
Total project cost (materials and installation):	$3,850 1st year

Action #4: Replacing Air-Operated Diaphragm Pumps

Although air-operated diaphragm pumps are not very energy efficient, they tolerate aggressive conditions relatively well and run without catastrophic damage even if the pump is dry. There are several questions to ask and areas to investigate that may yield significant air savings:

- Is an air-operated diaphragm pump the right answer? An electric pump is significantly more energy efficient. Electric motor-driven diaphragm pumps are readily available. An electric motor-driven progressive cavity pump may also work
- Consider installing electronic or ultrasonic controls to shut pumps off automatically when not needed. Remember, pumps waste the most air when they are pumping nothing

The group of projects recommended in the system assessment will reduce their energy costs by an estimated $364,211 (49% of current use).

THE SYSTEM ASSESSMENT OF THE MONTH

Four Action Items Save Money and Energy at a Refinery

Most optimization opportunities are present, and the potential for quick wins and very attractive project ROIs is very high.

"AREA A" & WASTEWATER					
Diaphragm Pumps	**3"**	**2" Wilden M8**	**1½"**	**1"**	**¾"**
Quantity	6	15	3	2	1
Location	Selenium/Waste	Selenium/Waste	Selenium	Selenium/Waste	Selenium/Chemical
Utilization	50% 88 psi 26 spm	F2320 (2) - 100% Remaining 25%	25%	25%	10%
Air Consumption (cfm/each)	105 cfm	75 cfm	40 cfm	20 cfm	20 cfm
Total Air Consumption	158 cfm	150 + 245 = 395 cfm	10 cfm	10 cfm	2 cfm

The total average compressed air used to run the diaphragm pumps is 565 scfm. The net annual average compressed air energy cost for these twenty-four (24) 1.5"–3" pumps is $140,801 per year. The net average demand of the three smaller ¾"–1" pumps (12 scfm) is $5,534 /yr.

The assessment recommends adding a MizAir pump control system, manufactured by ProportionAir, to the twenty-four (24) 1.5"–3" pumps in the production area. This will reduce the air demand by approximately 50% and keep throughput about the same by optimizing the stroke. Pump maintenance is also greatly reduced, and wearing parts last longer by using a microprocessor to control the stroke without end-of-stroke impact.

Net savings:	281 scfm
Annual recoverable electrical cost/cfm:	$250.09 scfm/yr
Total annual energy savings:	$69,488/yr
Purchase/installation cost of 24 MizAir and end-of-stoke sensors:	$72,000

Conclusion

This case study shows just how a large facility, growing over time, is the right situation for a compressed air system assessment. Most optimization opportunities are present, and the potential for quick wins and very attractive project ROIs is very high. Evaluating piping systems, upgrading air compressors and air dryers, conducting leak surveys and reviewing end uses were all areas that resulted in improvements in the compressed air system of this refinery. BP

For more information, please contact Hank Van Ormer, Air Power USA,
Tel: 740-862-4112, email: hank@airpowerusainc.com, www.airpowerusainc.com.

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THE ENERGY MANAGER

Vapor Recovery Units Manage Greenhouse Gases

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES®

Compressed Air Best Practices® interviewed Mr. Sid Van der Meer and Mr. Terry Nickel from Northwest Equipment Ltd in Airdrie, Canada.

Good morning. Why are Vapor Recovery Units important to managing greenhouse gas (GHG) emissions?

Good morning. Vapor Recovery Units prevent oil and natural gas upstream processes from emitting greenhouse gases. Underground crude oil, for example, contains some composition of gas vapors when it is brought to the surface and stored in a storage vessel. The largest component of these vapors is methane (between 40–60%). Other vapors can include propane, butane, ethane, nitrogen and carbon dioxide — to name a few. Methane, of course, is a greenhouse gas that remains in the atmosphere for approximately 9–15 years and is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide (CO_2).

In the past, "gas flaring" was a common process at well sites. These surplus, combustible vapors were seen as a "waste gas" or as a safety issue. The solution was to burn-off these vapors into the atmosphere. We can remember a time here in the Airdrie, Alberta region, that there were so many flares that at night they looked like streetlights!

Are there regulations covering "gas flaring" now in Canada?

Yes, there is now a strictly enforced regulatory environment for all "gas flaring". Canada now views gas flaring as an environmental problem, contributing significantly to global emissions. All oil and gas wells must comply with specific vapor recovery directives issued by the ERCB (Energy Resources Conservation Board).

The ERCB is a quasi-judicial agency of the government of Alberta. They issue directives and do inspections and monitor drilling operations. At first, oils and gas operators had to pay a fine for emitting any GHGs. Now, the ERCB will shut down a facility if vapor recovery processes are not adhered to and if any GHGs are emitted.

"Vapor Recovery Units prevent oil and natural gas upstream processes from emitting greenhouse gases."

— Sid Van der Meer and Terry Nickel from Northwest Equipment Ltd in Airdrie, Canada.

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What types of packages do you build for Vapor Recovery Units?

We build small and large packages. The small applications are designed to recover the vapors present at the top of the oil storage tank(s) at the drill site. These smaller packages use a 5 horsepower blower installed on top of a receiver tank. We run a line from the top of the oil storage tank over to our receiver tank. Our package includes a temperature switch and a differential pressure switch (from intake to discharge) on the blower.

As pressure builds up in the holding tanks for the oil, we will start up the blower to draw out the gas vapors. The blower will then push the gas into some process where they can re-use it or it will be sent to a natural gas compressor or

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"With the new regulations and inspections, we have seen a large increase in demand for Vapor Recovery Unit packages at these sites."

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engine. The suction pressure is in the range of a few ounces, and the discharge pressure is between 5–8 psig. A transmitter is reading suction pressure on the unit.

The air receiver acts as a separator and has its own liquid level gauge. Liquids settle out in the tank and the blower takes the gas off the top of the tank. We will take suction pressure from a positive few ounces to 5–8 psig to send it to process. Our transmitter is reading suction pressure.

What kind of blowers do you use and what does the total package look like?

We normally use the Tuthill PD Plus Series Blower. It is a double-envelope blower designed for gas. The double-envelope feature ensures a tight gas seal. This ensures ZERO gas leaks. You have to remember that many of these packages go inside a building. We actually build many structures/buildings for these packages. Leaks cannot be tolerated.

We have standardized double-envelope blowers for all installations involving vapor recovery. We are aware of some people selling single-envelope blowers for outdoor installations. We don't recommend this, as there can be leaks.

Please describe the larger packages.

When higher pressures are required, the vapor recovery units get larger in size. Higher pressures can be required because the gas has to be pushed a further distance or because it's being pushed into a higher-pressure line.

Vapor Recovery Unit with a 5 hp blower

Pictured on page 24 is a two-stage package built to achieve pressures exceeding 40 psi. The system is installed in a natural gas process plant designed to strip out unwanted gases. Multiple natural gas wells pipe into this centralized process plant. The application is to recover CO_2 and H_2S gas (hydrogen sulfide or sour gas) from natural gas. Hydrogen sulfide (H_2S) is a deadly gas — only 1 ppm from a H_2S leak can kill a man. They like to find it though, because they strip H_2S off to form sulfur for agricultural purposes. There is a lot of it here in Western Canada.

This two-stage unit has a 200 hp blower for the first stage. The second stage uses a 150 hp blower. Both blowers use Tuthill double-envelope, gas-type lobe technology. Both blowers are controlled by individual variable frequency drives. We chose individual VFDs because we are drawing off a process inlet flow, which varies greatly depending upon how much natural gas is there. We can't overdraw on their lines, so we control the speeds of the two blowers to match the interstage pressures (to maintain the pressure). We control the speeds of each blower to match or maintain intake, interstage and outlet pressures and ratios. Energy savings can also be achieved vs. some single-stage units, which have to use recirculated gas to maintain interstage pressures. In this manner, we are able to match input power requirements and eliminate recirculation gas.

Do you have to manage the condensate as well?

Yes. Natural gas is saturated or "wet". They want to collect these condensates because they contain valuable gases as well. We gather these liquids, after the first stage, in a mechanical separator vessel. There is a cooler to condense the liquids, the separator draws out the condensates, the dry gas goes into the second-stage blower, and then it's off to the process.

Vapor Recovery Units are enclosed in their own building

THE ENERGY MANAGER

Vapor Recovery Units Manage Greenhouse Gases

"Our region is famous for the "tar sands" (also known as the oil sands). A process used to extract oil here is called Steam Assisted Gravity Drainage (SAGD). Steam is injected into the upper wellbores to heat the reservoir. As a result, bitumen drains into lower wellbores and is brought to the surface."

— Sid Van der Meer and Terry Nickel

Do you ever reach pressures requiring a compressor?

Yes. We have seen small-flow applications at higher pressures in the 60–100 psig range. There have been applications with natural gas requiring higher pressures due to the long distances the gas has to travel and due to pressure losses in the pipes.

In these cases, the unit will take elevated suction pressures of up to 5 psig, and go to a 60–100 psig discharge pressure. Some well pressures do reach 5 psig. The gas compressors are specially formulated to handle the rigors of gas and a 2–3% H_2S content. All yellow metals are removed from the compressor internals. The gas intake assembly is configured to have a threaded inlet (for pipe intake), the intake cover assembly ensures a sealed unit and oversized oil-cooler and after-coolers with CRN registrations are specified. The unit also has a remote oil filter system and uses special oils (with better emulsification), which won't get chewed up by the H_2S.

Do instrument gas systems need vapor recovery packages too?

Yes. We have designed instrument gas systems for many years for customers who didn't have compressed air onsite to run their valve and actuator instruments. Instead, they used the natural gas they had onsite, and would flare off any excess gas. With the new regulations and inspections, we have seen a large increase in demand for Vapor Recovery Unit packages at these sites. These customers now have to install an Instrument Air package and a Vapor Recovery Unit to deal with these vapors. In general, this market is decommissioning the use of instrument gas and putting in instrument air packages. This is just getting started due to GHG emissions, as they are going for 0% gas flaring in the whole process.

A two-stage blower package delivers 40 psig pressure

Are there any other new applications for Vapor Recovery Units?

Absolutely. Our region is famous for the "tar sands" (also known as the oil sands). A process used to extract oil here is called Steam Assisted Gravity Drainage (SAGD). Steam is injected into the upper wellbores to heat the reservoir. As a result, bitumen drains into lower wellbores and is brought to the surface.

The oil sands industry, using SAGD processes, is now designing new systems where the water is boiled off and turned into steam. It is then sent into evaporators, recondensing water out and separating the other gases. We are involved with supplying 20 hp blowers to take steam at a low pressure and draw it through an inlet scrubber. We then push it downstream into a gas separation process. This process delivers 0% gas venting — and the ducks are safe! BP

Thank you for your insights.

For more information, please contact Sid Van der Meer, Northwest Equipment, Tel: 403-945-1988, email: sid@nwequipltd.com, www.nwequipltd.com.

Gas compressor package for 60–100 psig pressure

THE TECHNOLOGY PROVIDER

Large Designs — Small Compressors at Hycomp, Inc.

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES®

"We get our engineers involved with our customers' engineers and ensure that we are designing, building and certifying every compressor as an exact match to each customer's application."

— Robert James, President and CEO of Hycomp, Inc.

Hycomp Success in the Oil and Gas Industry

There are many applications that require a low-horsepower compressor built with the technology that has been proven in larger compressors. Often, these situations are not addressed well by the general compressor industry.

Hycomp makes a point of focusing on some of these niche applications, building smaller-scale units that are designed for continuous-duty, critical performance situations. These are the reasons that companies like Chevron, Texaco, Exxon, BP, Sonatrach and Petrofac look to Hycomp for solutions to their unique problems.

Large Design — Small Compressor

Over the years, continuing downward price pressure has driven many manufacturers of small- to mid-size compressors toward lower-cost and lower-quality designs and materials. Hycomp utilizes heavy-duty construction that incorporates the benefits of larger designs into even their smallest compressors. Hycomp manufactures compressors that provide longevity and continuous oil-free service by taking advantage of cast iron cylinders and heads, pressure oil lubricated crankcases and a variety of ring and gas packing materials.

"We typically deal with higher horsepower and higher flow applications in refining and process gases," said Bruce Hermonat, a compression solutions engineer at Hoerbiger. "The double distance piece design allows the Hycomp gas compressor to fill a lower horsepower fit that is capable of compressing hazardous process gases. Hycomp gas compressors represent an effective solution for smaller horsepower (1–75 hp) and quick delivery applications."

How the Tough Applications Are Addressed

Robert James, president and CEO of Hycomp, Inc., explained how they can offer solutions to even the toughest applications, "We begin by acknowledging that every application and every customer has unique requirements. With this open mindset, we get our engineers involved with our customers' engineers and ensure that we are designing, building and certifying every compressor as an exact match to each customer's application."

James continues, "We are able to do this and keep our costs competitive because of our modular compressor designs. Our modular system of engineering and manufacturing creates nearly endless compression possibilities. In other words, our engineered solutions are flexible to your requirements. Our wide range of high-quality materials provides many options to match the compatibility requirements of most industrial gases."

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THE TECHNOLOGY PROVIDER

Large Designs — Small Compressors at Hycomp, Inc.

Hycomp can provide a complete package designed for installation in a hazardous classified area, per the customer's requirements, whether those requirements are UL®, CSA or ATEX based."

Hycomp's ability to adapt and provide solutions is advantageous to their distributors as well. "Hycomp gas compressors fit into applications that have nasty components, such as gases like hydrogen sulfide and wet carbon dioxide, while adapting to custom pressures and flows," said Steve Krupski of Pump Sales & Service. "Other compressor manufacturers have a limited number of compressors that might work for an application, but if they are not the right fit, you're out of luck. Hycomp engineers get heavily involved to provide customized compressors that are an exact fit for what you need. In my 25 years of experience, I have found Hycomp products to be well designed and engineered, and their staff is very responsive."

Reliability and Length of Service Is Critical

Hycomp designs and sizes their compressors for true continuous duty. Speed is paramount, as the compressors are engineered to run slower and can handle a full 60 minutes per hour, 24 hours a day, 365 days a year of continuous operation, without introducing contamination from wear and breakdown into the customer's process. Unplanned downtime is not an option for most of their customers, so they design and build quality compressors that provide worry-free operation.

Jeremy Olson, general manager of Green River Power Service, Inc., had some reliability issues with compressors he was using in an unmanned natural gas processing facility. "We had been getting between 3–9 months on a competitor's compressor. Since we installed the Hycomp compressor in November of 2008, it has run flawlessly. The internal construction [of the Hycomp gas compressor] is far superior. We have been very pleased with Hycomp's service and reliability."

Safety First

Customer safety is absolutely imperative. Hycomp is also an integrated package provider. They are able to design both the compressor and the package to be safely operated in a potentially explosive environment created by the presence of flammable gas. They can provide a complete package designed for installation in a hazardous classified area, per the customer's requirements, whether those requirements are UL®, CSA or ATEX based.

Hycomp provides three increasingly secure methods of gas leakage control. The B-Series addresses inert gases, the G-Series handles standard industrial and oil field gases and the H- Series provides extreme gas control. When dealing with gas mixtures, it is important to examine not only the individual gas constituents and their individual effect on design, but also to examine the mixture as a whole. Certain gases interact with others to become more corrosive, toxic or flammable than they are in their pure form. Hycomp addresses these concerns at the compressor design level, thus solving potentially dangerous problems before they can occur.

Intake and Packings

Hycomp's unique "plenum intake" design receives gas below the compression cylinder through the plenum chamber. This innovative style of intake and compression provides three major benefits: a cooling effect on piston rings and packings, balanced piston rod loads and a small internal gas reservoir. Hycomp gas packing arrangements provide the necessary protection to keep outside contaminates out of the process, gas leakage to a minimum and control increased.

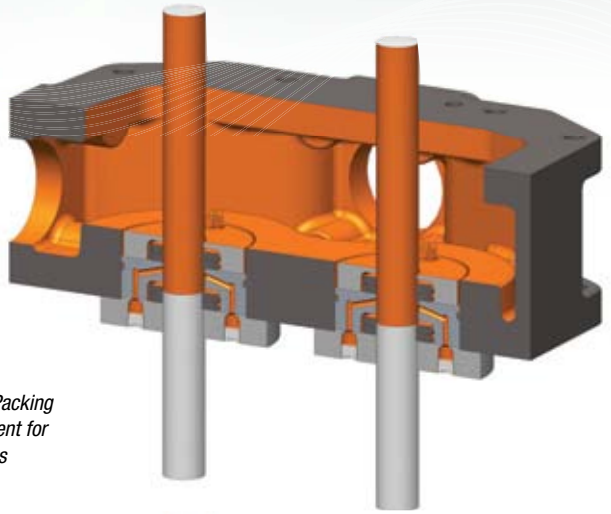
Hycomp's B-Series packing arrangement is a non-vented design utilizing tangent-tangent piston rod packings to contain non-hazardous/non-contaminating gases. The packing arrangement style is designed for inert gases such as air or nitrogen.

Hycomp's G-Series packing arrangement is an internally vented design utilizing a combination of radial-tangent and tangent-tangent piston rod packings. The vented arrangement accomplishes everything the B-Series does, while providing the ability to vent or purge the gas when needed. This is a benefit when dealing with gases that are more dangerous or expensive and can be vented/flared or recaptured.

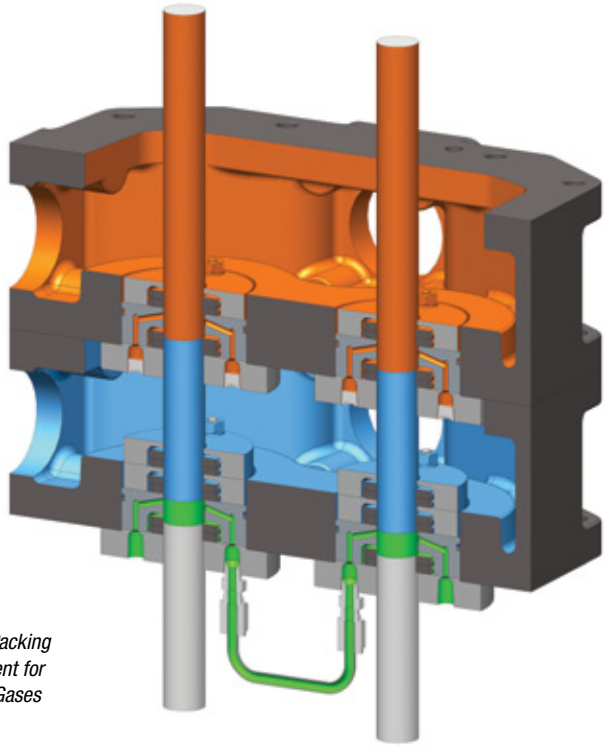
Hycomp's H-Series packing arrangement is designed to compress difficult-to-contain and potentially dangerous gases. This packing arrangement style utilizes a double plenum chamber each with its own gas packing case. The upper plenum chamber contains their B-style packing arrangement, while the lower plenum chamber contains the vented G-style packing arrangement. The combination allows for three possible vent/pad/purge locations, providing a wide range of leakage control.

Smaller Compressors, No Small Details

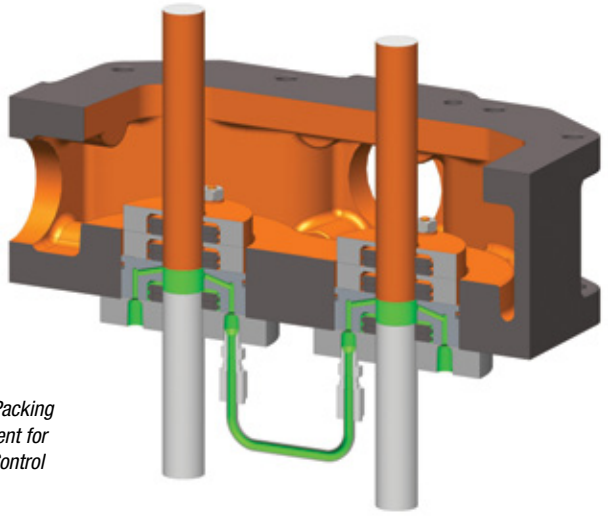
Since Hycomp works closely with each customer's engineering team, they gain a clear understanding of the critical nature of the customer's installations. They understand that customers can't afford compromises on the material and design details of materials used in their compressors.



B-Series Packing Arrangement for Inert Gases



G-Series Packing Arrangement for Industrial Gases



H-Series Packing Arrangement for Extreme Control

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Large Designs — Small Compressors at Hycomp, Inc.

Valves

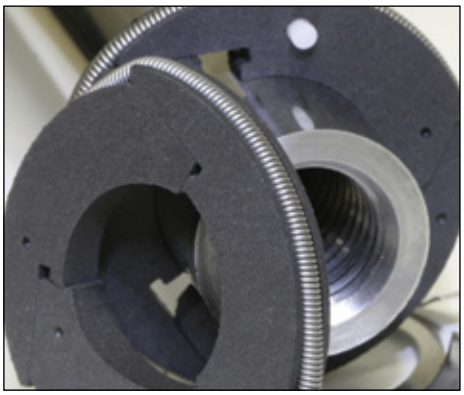
High-quality valve construction dictates that valve bodies are made from the highest quality 400 series stainless steels, which have been heat-treated for hardness and toughness. Valve plates are machined of precipitation-hardenable stainless steel or crystallized PEEK, depending upon the pressures and temperatures of the service.

By design, Hycomp valve plates are frictionless guided so there is no valve cage wear. The valve port design has been refined to provide improved flow efficiency, saving power and decreasing valve impact forces. Larger valves are dampened, providing additional wear reduction without sacrificing flow efficiency. And of course, all valves are removable with minimal effort and re-buildable on site.

Piston Rings

The proper selection of piston ring material and design will add years of reliable service to a gas compressor. Hycomp uses seven different polymer-based piston ring materials to meet today's varying gas demands. From PTFE to PEEK and PPS, the right ring material is selected for the application.

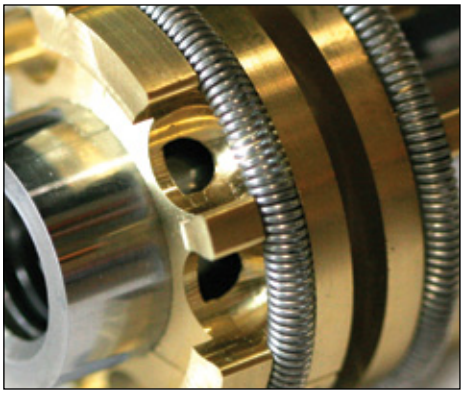
Their angle cut design for rings enables flexing of the ring end to seal the gap better than butt cut designs, yet retains its strength vs. step cut designs. In situations where gap leakage becomes significant, such as with low molecular weight gases and small cylinder bores, a two-piece, L-style ring design can be used, which removes the end gap by using an inner and outer ring for sealing.



Rod Packings

Piston rod gas packings perform the critical function of containing the gas in the compressor, while providing pressure on the underside of the pistons to balance the rod loads. The segmented packing design is free floating and self-adjusting for long wear life. The design inherently continues to seal as the packing wears. A pair of packings is pinned together at the proper rotational offset to ensure that the leakpath created by the cuts are sealed.

Just like piston rings, Hycomp stocks seven different packing materials to meet the needs of the application. And, unlike chevron-type packings, segmented packings do not need periodic adjustment to ensure a tight seal.



Piston Rod Oil Scrapers

Oil scrapers perform the essential service of preventing oil from migrating out of the crankcase and into the gas stream. Combined with the open distance piece design, which allows residual oil vapor to escape the machine, Hycomp piston rod oil scrapers provide a leak-free seal on the pressure oil-lubricated bottom end.

Segmentally cut scrapers are based on a similar principal to the Hycomp gas packings. They continue to adjust as they wear. The sharp edges machined into the brass scraper remove oil from the rods, while the liberal porting allows the oil to flow back into the crankcase. As the scrapers are a softer material than the piston rod, the brass scraper wears while the rod does not.

How and Where Hycomp Gas Compressors Are Being Used

Nitrogen Blanketing: Oil Recovery

The topside process and facilities modules for the Vincent FPSO ship (Floating Production, Storage and Offloading) require a large high-pressure gas compressor that boosts the gas from the oil wells. This compressor requires nitrogen to purge and pressurize the seals/gaskets during cold start and startup procedures. The nitrogen compressor system was required to be ATEX certified for explosive atmospheres and resistant to the corrosive offshore marine environment. Compounding the difficulty, lead time was limited to five weeks.

Hycomp provided a solution that met the ATEX requirements and featured a marine offshore coating system on the entire package. Hycomp was also able to meet the required lead time of five weeks by working directly with the Norwegian engineers, solving potential problems before they could occur.

Model: AN12B-B201
Gas: Nitrogen
Suction Pressure: 65 psig
Discharge Pressure: 145 psig
Flow: 63 scfm

Natural Gas: Tank Farm

In the oil and gas industry, tank farms utilize vapor recovery to keep costs down and remain efficient while meeting EPA government requirements. A Wyoming-based tank farm needed to reclaim the wasted gas vapor exiting their low displacement storage tanks and return it back into their process.

Seven Hycomp AN12B-G221 oil free vapor recovery gas compressors were contracted and installed on separate tanks. By reclaiming the gas vapor and sending it back through the system, the customer is now able to keep the gas instead of wasting it through flaring.

Hycomp gas compressors offer a high level of energy efficiency. Variable frequency drives were packaged with all seven oil free vapor recovery gas compressors. The VFDs add to each compressor's overall efficiency, as they adjust motor speeds according to workload. No gas enters the crankcase of Hycomp compressors; therefore, the internal running crankcase components experience a much longer life. The natural gas is safely and reliably compressed, while helping reduce the customer's carbon footprint. BP

For more information, please contact Ken Schiefer, Area Sales Manager, Hycomp Inc., Tel: 435-562-3695, email: kschiefer@hycompusa.com, www.hycompusa.com.

Model: AN12B-G221
Gas: .65 SG Natural Gas
Suction Pressure: 0 psig
Discharge Pressure: 40 psig
Flow: 6–12 mcfd

ENERGY INCENTIVES

Motor Incentives for Water-Injection Oil Recovery Systems

BY ROD VICKERS, SOUTHERN CALIFORNIA EDISON

WESTMINSTER, CA. – Discovered in 1932, the Wilmington Field in Southern California is the third largest oil field in the United States. Over the past 20 years, however, annual production has fallen by more than two-thirds. As the field has matured, producers have increased their reliance on secondary waterflooding/water injection enhanced oil recovery strategies to coax the remaining reserves to the surface.

Water injection has been used since 1953 in the Long Beach harbor area of the reservoir, leading to high water cuts. Reinjecting produced water is also mandated by law to prevent ground subsidence, which reached a maximum of 30 feet of elevation change in the mid-1940s, caused by years of fluid extraction. Maintaining production levels is a constant struggle that requires the use of advanced technologies and techniques. Waterflooding/injection is one technique that requires considerable energy to handle and inject the substantial amount of water needed for enhanced recovery. Fortunately, there are opportunities for efficiency improvements on these systems that can directly improve the economic bottom line.

The ultimate goal of flooding/injecting water into a mature reservoir is to recreate the natural pressure that was depleted during primary recovery and drive the remaining oil toward the production zones. Typically, several injection wells are completed for each producing zone, usually placed to maximize the sweeping effect of injected water through the targeted zones. The water must be injected at sufficient pressures and volumes to fill the "voids" created by past oil production. The pumping plants that feed the injection wells pump thousands of barrels of water a day at pressures of 1,000 psi or greater. Generally, the prime movers are large (500–3,000 horsepower) electric motors that drive multiple-stage centrifugal pumps. These pumps also require supporting centrifugal charge pumps driven by motors in the range of 50+ horsepower. Energy is also required for water handling at the surface to separate the oil and water, and to transfer the water to the injection sites (Figure 1). These three classes of pumps — injection, charge and transfer — are all critical and interdependent.

The process is cyclic, in that the water used for injection is recovered and then recycled to enhance oil recovery. Energy costs can run as high as $.075 per barrel to reinject produced water, which is usually greater than 95% of the total fluid produced. With the increasing cost of electricity in Southern California and greater emphasis on greenhouse gas emission reduction efforts, paying attention to the energy intensity of a waterflood strategy and pumping systems in general is a very worthwhile effort for producers using this methodology for extraction. This focus not only pays dividends in operational cost savings, but can also reduce the carbon footprint of these operations.

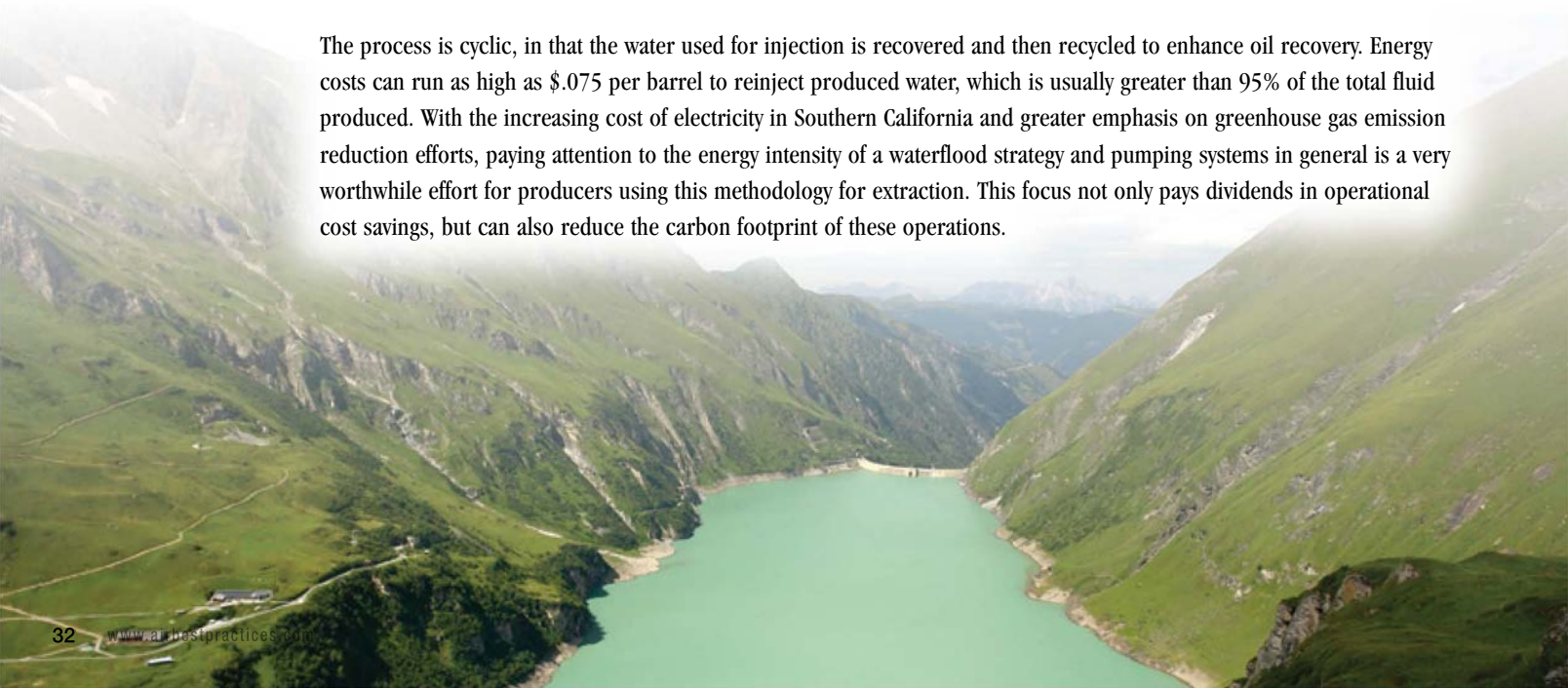


FIGURE 1

Typical Waterflood Pumping Requirements

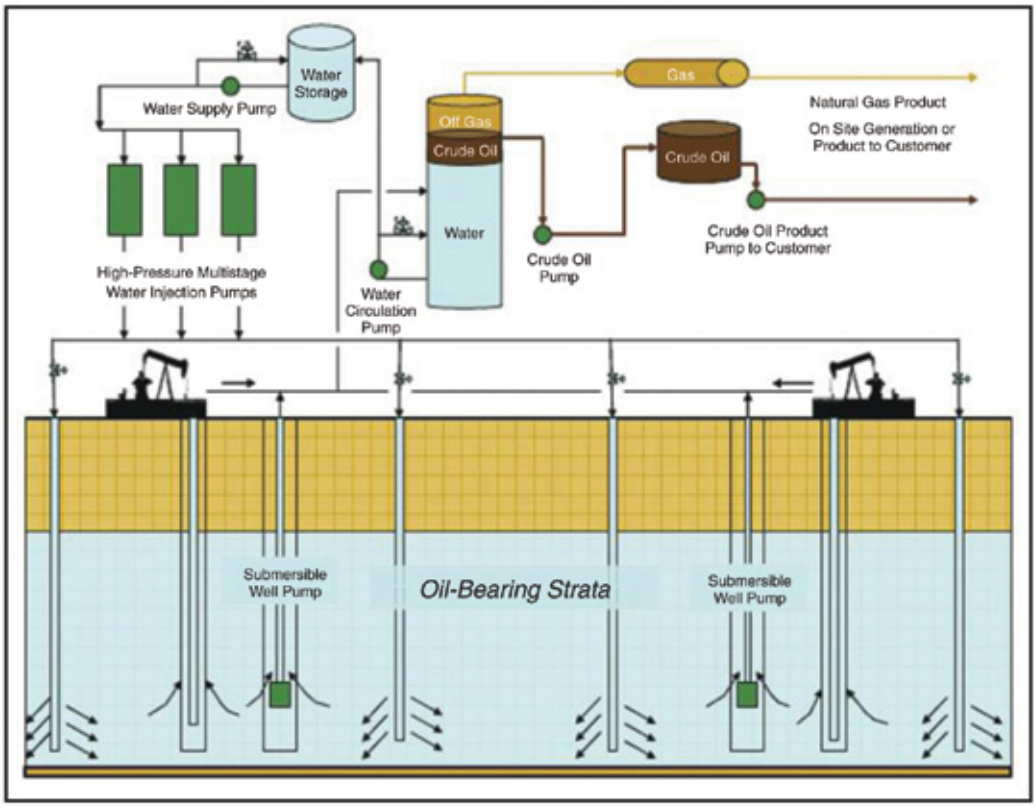
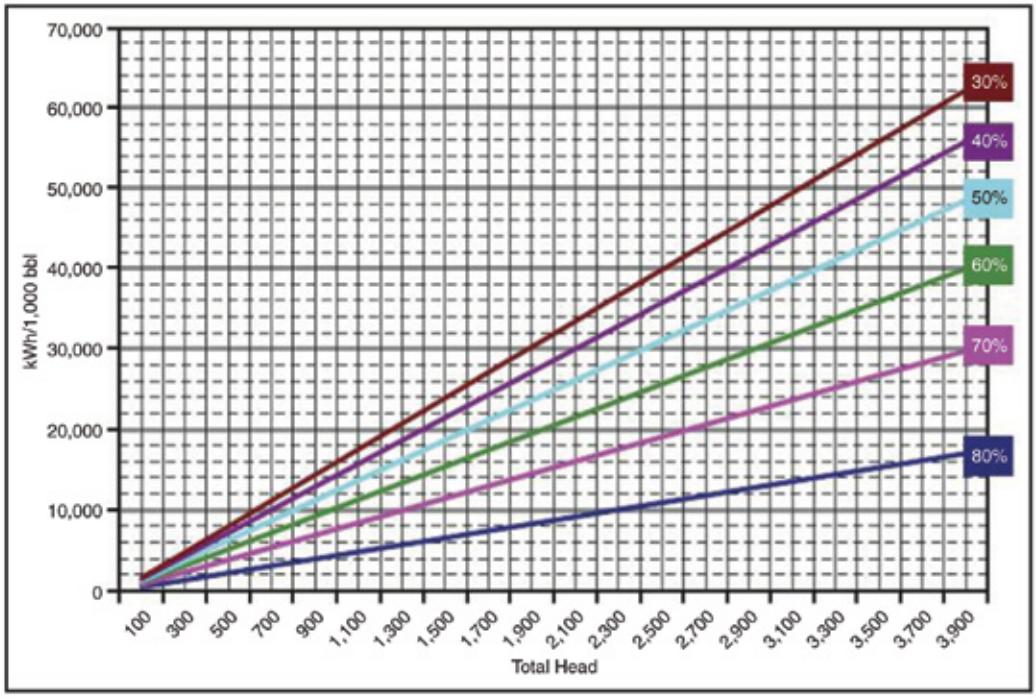


FIGURE 2

kWh per 1,000 Barrels at Various Overall Plant Efficiencies



ENERGY INCENTIVES

Motor Incentives for Water-Injection Oil Recovery Systems

Efficiency And Lifecycle Cost

The U.S. Department of Energy estimates that more than 50% of the lifecycle cost of a pump system is attributed to energy and maintenance, with as little as 10% related to purchase and installation costs. This statistic hits home for producers active in the Wilmington reservoir, where a water injection strategy is standard operating procedure, and the operating environment is extremely harsh, with less-than-ideal water quality, heat, silt, sand and salt all taking their toll on equipment.

One resource available in some areas to oil and gas producers are electric utility company programs designed to help users of energy-intensive pumping equipment analyze and optimize the performance of their operations. In Wilmington reservoir waterfloods, for example, Southern California Edison's hydraulic services department can be a valuable resource for the mainly independent operators active in the field.

The department has been serving Southern California for nearly 100 years. Originally, its pump test technicians were tasked with helping agriculture customers see the benefits of using electricity for water pumping versus internal combustion engines. The service has evolved over the years and has come to be relied on by many customers to help monitor the health of their water pumping operations, keeping them reliable and efficient.

For SCE customers, the hydraulic services department will provide a complimentary report on a pumping plant's efficiency that details whether the pump is matched to the task, and where the system's current overall plant efficiency (OPE) stands in relation to the optimal OPE. Over the past two years, SCE's hydraulic services department has expanded its services to also address industrial applications. Waterflood producers were a natural focal point because of the large amounts of water handling and injection. These types of tests are also offered by many pump service companies, and can be performed in house with some research and a small investment.

Win/Win Opportunities

Generally, the reliable function of these pumping systems has trumped other concerns such as electricity costs. There is, however, an intersection of the ideas relating to energy efficiency and reliability that is beneficial to everyone, specifically with regard to waterflood operations. Projects that increase reliability and reduce energy consumption are a great model of a win/win for all parties involved. Operational savings through maintaining efficiencies at prescribed ranges not only adds to the profit margin of operations, but it also improves the reliability of equipment (Figure 2). In some instances, improving efficiencies may lead to shutting down other pumps, thereby extending the effective useful life of the system.

Under SCE's industrial pump test program, system or plant efficiency projects may qualify for incentives that effectively reduce the payback periods for many projects. As an example, an operator might be running three older, inefficient charge pumps to do the work of two efficient pumps. By performing field pump tests, this opportunity can be identified and two of the pumps can be rebuilt or replaced to meet the original flow and pressure requirements. This simple strategy could allow the third, less-efficient pump to be idled as a backup, saving energy and greenhouse gas emissions, providing operational redundancy and providing a cash incentive.

Another option for the same scenario could be that all three pumps are rebuilt, again increasing reliability and efficiency, but all three would be put back into service, thereby increasing injection rates and production. In this case, incentives could be paid based on better energy intensity, or decreased kilowatt-hour/barrel consumption. SCE pays an incentive of $.08 per kWh for the first year savings in a lump sum, up to 50% of the total project cost. Table 1 shows the potential savings over five years associated with an efficient 1,500 hp, 1,700 psi pump versus an inefficient system of the same size.

One Southern California operator has taken advantage of this intersection of reliability and energy efficiency by leveraging the capabilities of SCE's hydraulic services department. An opportunity was discovered for a high-pressure multistage centrifugal pump, which was identified as deviating significantly from its optimal OPE point through an evaluation provided by an SCE pump test.

By rebuilding the pump and replacing the 1,500 hp motor driving it with a new and slightly higher-efficiency unit, the project increased overall plant efficiency from 57–68%, saving 1.6 million kWhs and resulting in an annual savings of nearly $130,000 and a reduction in carbon dioxide emissions of 1.4 million pounds (attributed to reduced electrical generation). In addition to these savings, SCE paid an incentive equal to 45% of the project cost, resulting in an accelerated simple payback of only 11 months.

An early indication of what could have been a possible failure of the pump allowed the producer to plan for the replacement, rather than be forced to react after the pump had failed. The obvious benefits of increased reliability are uninterrupted and higher production. The less obvious advantages are the avoided costs of an unplanned production interruption and recovering production after a failure. In these cases, a pump will often be replaced with a mismatched unit, or the failed unit will be quickly repaired with little, if any, consideration given to efficiency, which can ultimately lead to significant dollars lost over time because of unnecessary and excessive energy consumption.

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Working Together for Compressed Air Best Practices

Compressed Air Best Practices® is a technical magazine dedicated to discovering **Energy Savings** and **Productivity Improvement Opportunities** in Compressed Air Systems for specific **Focus Industries**. Each edition outlines "Best Practices" for compressed air users — particularly those involved in **managing energy costs in multi-factory organizations**.

Utility and Energy Engineers, Utility Providers and Compressed Air Auditors share techniques on how to audit the "demand-side" of a system — including the **Pneumatic Circuits** on machines. This application knowledge allows the Magazine to recommend "**Best Practices**" for the "supply-side" of the system. For this reason we feature **air compressor, air treatment, measurement and management, pneumatics, blower and vacuum** technologies as they relate to the requirements of the monthly **Focus Industry**.

- **Compressed Air Users — Focus Industry**
  - A. Energy and Utility Managers share experiences
  - B. Audit case studies and "Best Practice" recommendations
- **Utility Providers & Air Auditors**
  - A. Utility Company Rebate Programs
  - B. Case Studies by Expert Compressed Air Auditors
- **Compressed Air Industry**
  - A. Profiles of Manufacturers and Distributors
  - B. Product Technologies Best Suited for the Focus Industries
  - C. Industry News

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International pricing for print edition — $65 in Canada and $95 for other countries.

ENERGY INCENTIVES

Motor Incentives for Water-Injection Oil Recovery Systems

Other Cost-Effective Options

Of course, there are other opportunities available. Simple policies of replacing failed pump motors with National Electric Manufacturers Association (NEMA) premium models can result in substantial lifecycle cost savings. As an example, replacing a 100 hp standard efficient motor driving a charge pump with a NEMA premium model would result in an annual savings of 5,913 kWh (or $532) per year, while also reducing carbon dioxide emissions by 5,144 pounds per year. Most utilities offer rebates on such upgrades, based on horsepower and motor speed, that will help offset the cost difference between standard and premium motors.

Another option on dynamic systems is utilizing a variable speed drive. In situations where a pump system may be oversized to accommodate future expansion, or on a system with variable flows and pressures, a variable frequency drive can be a great alternative to a control valve and/or fluid bypass to control flow and pressure. Variable frequency drives control motors by reducing the incoming electrical frequency to less than 60 Hertz when system demands are lower, taking advantage of the exponential ratio of required horsepower to speed.

One California producer employed this strategy when it installed a new horizontal injection pump. The new system had a capacity of 37,660 bbl/day, but would not be fully utilized for several years. The variable frequency drive enabled the company to meet both its current and future needs, while saving $73,241 a year and avoiding excess stress and wear on the system caused by regulating flow through control valve/bypass. In this case, an incentive of $65,103 was paid by the utility for the avoided energy consumption of 813,791 kWhs.

One of the best efficiency options is to correctly size the pumping system from the start. Pump systems are commonly engineered with safety margins between 10–50%, resulting in the system operating off of its best efficiency point on its design curve. There are many resources available to meet the challenge of sizing systems properly and monitoring their performance, either from utilities, vendors or tools, such as the Pump System Assessment Tool (PSAT), a free software program available from the U.S. Energy Department.

As the energy efficiency goals and greenhouse gas emissions limits assigned to utilities have increased, so have the available programs and resources designed help to achieve these goals. For instance, SCE has created an industrial energy efficiency program that contracts with energy engineering firms to provide support specifically to the oil and gas production industry, with a focus on identifying, quantifying and pursuing incentives for energy-efficient projects.

Other options are utilizing some of the free information resources available, such as the Department of Energy or Pump Systems Matter, both of which have extensive assessment toolboxes and case studies. All producers should take a look at these very hard-working pumping systems, which all too often are not thought of until they fail, and take advantage of the resources and incentives available to increase the productivity, reliability and cost effectiveness of all their pumping applications. BP

For more information, please contact Rod Vickers, SCE Account Manager, Tel: 714-895-0211, email: vickerrd@sce.com, or visit www.sce.com

DISTRIBUTION PIPING

Understanding Pressure Drop

BY THE COMPRESSED AIR CHALLENGE®

The Compressed Air Challenge® (CAC) is a voluntary collaboration of industrial users, manufacturers, distributors and their associations, consultants, state research and development agencies, energy efficiency organizations and utilities. This group has one purpose in mind — helping you enjoy the benefits of improved performance of your compressed air system. The mission of the Compressed Air Challenge® (CAC) is to provide resources that educate industrial users about optimizing their compressed air systems.

One of the many issues that can affect compressed air system efficiency and pressure stability is pressure drop. "The first and foremost complaint I normally hear from an operator or production area is, 'I don't have enough pressure'," says Frank Moskowitz, one of CAC's advanced management instructors. "The air compressor operator usually gets the blame, but often the problem is actually a flow restriction that manifests itself as low pressure."

"Pressure drop problems can stem from undersized distribution piping, which leads air system operators to spend significant time and money to optimize their distribution systems," says Tom Taranto, another CAC advanced management instructor. "But often, most of the problem is between the header and machine in the last 30 feet of piping, or what I call the 'last dirty thirty'. Students of our fundamentals and advanced seminars will learn about these issues and some strategies needed to pinpoint these problems."

The Compressed Air Challenge® has developed some resources to help understand pressure drop and its effects, and point the way in what to do about it. Participants in our **Fundamentals and Advanced Management of Compressed Air Systems** training learn about pressure drop and how to recognize it in their systems. There are also some written resources available. The following are two excerpts from CAC-developed documents. For more information about these useful information sources and to access many others, please visit our website at **www.compressedairchallenge.org.**

*The Compressed Air Challenge® (CAC) is pleased to announce the launch of Fundamentals of Compressed Air Systems WE (web based) on February 22, 2010. Led by Frank Moskowitz and Tom Taranto, this web-based version of the popular Fundamentals of Compressed Air Systems training uses an interactive format that enables the instructor to diagram examples, give pop quizzes and answer students' questions in real time. The introductory rate for the course is $795 and participation is limited to 25 students. Please visit the CAC website today (**www.compressedairchallenge.org**) to access online registration and for more information about the training. The deadline for registration is February 8, 2010.*

*If you have additional questions about the new web-based training or other CAC training opportunities, please contact the CAC at **info@compressedairchallenge.org** or call 301-751-0115.*

DISTRIBUTION PIPING: UNDERSTANDING PRESSURE DROP

Pressure Drop

Following is an excerpt from CAC's **Improving Compressed Air System Performance: A Sourcebook for Industry**.

Pressure drop is a term used to characterize the reduction in air pressure from the compressor discharge to the actual point-of-use. Pressure drop occurs as the compressed air travels through the treatment and distribution system. A properly designed system should have a pressure loss of much less than 10% of the compressor's discharge pressure, measured from the receiver tank output to the point-of-use.

Excessive pressure drop will result in poor system performance and excessive energy consumption. Flow restrictions of any type in a system require higher operating pressures than are needed, resulting in higher energy consumption. Minimizing differentials in all parts of the system is an important part of efficient operation. Pressure drop upstream of the compressor signal requires higher compression pressures to achieve the control settings on the compressor. The most typical problem areas include the aftercooler, lubricant separators and check valves. A rule of thumb for systems in the 100 psig range is: for every 2 psi increase in discharge pressure, energy consumption will increase by approximately 1% at full output flow (check performance curves for centrifugal and two-stage, lubricant-injected rotary screw compressors).

There is also another penalty for higher-than-needed pressure. Raising the compressor discharge pressure increases the demand of every unregulated usage, including leaks, open blowing, etc. Although it varies by plant, unregulated usage is commonly as high as 30–50% of air demand. For systems in the 100 psig range with 30–50% unregulated usage, a 2 psi increase in header pressure will increase energy consumption by about another 0.6–1% because of the additional unregulated air being consumed. The combined effect results in a total increase in energy consumption of about 1.6–2% for every 2 psi increase in discharge pressure for a system in the 100 psig range with 30–50% unregulated usage.

An air compressor capacity control pressure signal is normally located at the discharge of the compressor package. When the signal location is moved downstream of the compressed air dryers and filters to achieve a common signal for all compressors, some dangers must be recognized and precautionary measures taken. The control range pressure setting must be reduced to allow for actual and potential increasing pressure drop across the dryers and filters. Provisions also must be made to prevent exceeding the maximum allowable discharge pressure and drive motor amps of each compressor in the system.

Pressure drop in the distribution system and in hoses and flexible connections at points-of-use results in lower operating pressure at the points-of-use. If the point-of use operating pressure has to be increased, try reducing the pressure drops in the system before adding capacity or increasing the system pressure. Increasing the compressor discharge pressure or adding compressor capacity results in significant increases in energy consumption.

Elevating system pressure increases unregulated uses, such as leaks, open blowing and production applications, without regulators or with wide-open regulators. The added demand at elevated pressure is termed "artificial demand", and substantially increases energy consumption. Instead of increasing the compressor discharge pressure or adding additional compressor capacity, alternative solutions should be sought, such as reduced pressure drop and strategic compressed air storage. Equipment should be specified and operated at the lowest efficient operating pressure.

What Causes Pressure Drop?

Any type of obstruction, restriction or roughness in the system will cause resistance to air flow and cause pressure drop. In the distribution system, the highest pressure drops are usually found at the points-of-use, including undersized or leaking hoses, tubes, disconnects, filters, regulators and lubricators (FRLs). On the supply side of the system, air/lubricant separators, after coolers, moisture separators, dryers and filters can be the main items causing significant pressure drops.

The maximum pressure drop from the supply side to the points-of-use will occur when the compressed air flow rate and temperature are highest. System components should be selected based upon these conditions, and the manufacturer of each component should be requested to supply pressure drop information under these conditions. When selecting filters, remember that they will get dirty. Dirt loading characteristics are also important selection criteria. Large end users who purchase substantial quantities of components should work with their suppliers to ensure that products meet the desired specifications for differential pressure and other characteristics.

The distribution piping system often is diagnosed as having excess pressure drop because a point-of-use pressure regulator cannot sustain the required downstream pressure. If such a regulator is set at 85 psig and the regulator and/or the upstream filter has a pressure drop of 20 psi, the system upstream of the filter and regulator would have to maintain at least 105 psig. The 20 psi pressure drop may be blamed

on the system piping rather than on the components truly at fault. The correct diagnosis requires pressure measurements at different points in the system to identify the component(s) causing the excess pressure drop. In this case, the filter element should be replaced or the filter regulator size should be increased, not the piping.

Minimizing Pressure Drop

Minimizing pressure drop requires a systems approach in design and maintenance of the system. Air treatment components, such as after coolers, moisture separators, dryers and filters, should be selected with the lowest possible pressure drop at specified maximum operating conditions. When installed, the recommended maintenance procedures should be followed and documented. Additional ways to minimize pressure drop are as follows:

- Properly design the distribution system
- Operate and maintain air filtering and drying equipment to reduce the effects of moisture, such as pipe corrosion
- Select after coolers, separators, dryers and filters with the lowest possible pressure drop for the rated conditions
- Reduce the distance the air travels through the distribution system

Specify pressure regulators, lubricators, hoses and connections having the best performance characteristics at the lowest pressure differential. These components must be sized based upon the actual rate of flow and not the average rate of flow.

Best Practices and Tips for Compressed Air Piping Systems

A brief synopsis of "Section 3, Distribution System" from **Best Practices for Compressed Air Systems** follows. This 325-page book is available at our **bookstore.**

Pressure losses due to inadequate piping will result in increased energy costs and variations in the system pressure, with adverse effects on the production process.

How to Select Pipe Sizes:

The compressor room header into which the air compressor(s) discharge(s), should be sized so that the air velocity within the header does not exceed 20 ft/sec, thus allowing for future expansion. Distribution header piping leaving the compressor room should be sized to allow an air velocity not to exceed 30 ft/sec, to minimize pressure drop.

It also is recommended that the air from each compressor not enter the header at 90˚ to the header axis, but at a 45˚ angle in the direction of flow and always using wide radius elbows.

Iron and carbon steel piping is generally sized by the nominal bore diameter. Copper and steel tubing normally is sized by outside diameter.

Any type of obstruction, restriction or roughness in the system will cause resistance to air flow and cause pressure drop.

DISTRIBUTION PIPING: UNDERSTANDING PRESSURE DROP

How About the Future?

The main header and distribution piping should be sized to take into account anticipated future expansions. If the initial piping is sized only for present flow requirements, then any additions will cause increased pressure losses in the entire system.

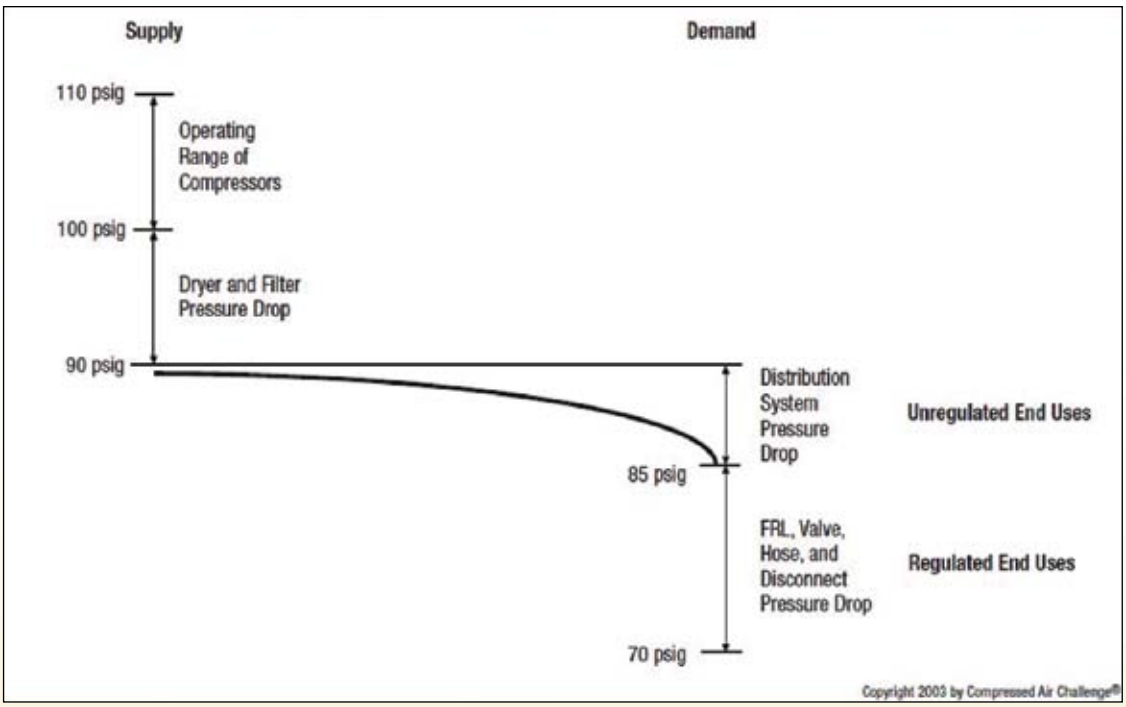
The next-larger size pipe will add to materials costs, but may add little to installation labor costs and should reduce the pressure drop substantially, with corresponding savings in operating costs.

How about Materials?

Many industrial plants use schedule 40 steel piping, with or without galvanizing, for 100–125 psig service. Many food, pharmaceutical, textile and other plants that use non-lubricated compressors install stainless steel piping to avoid potential corrosion problems and the resulting downstream contamination.

For special applications, federal, state and local codes should be consulted before deciding on the type of piping to be used. The usual standard to be applied is ANSI B31.1. For Healthcare facilities, consult Standard NFPA 99 of The National Fire Protection Association. BP

For more information, please visit ***www.compressedairchallenge.org.***



CAC Training can help you discover your plant's pressure profile

"The air compressor operator usually gets the blame, but often the problem is actually a flow restriction that manifests itself as low pressure."

— Frank Moskowitz, CAC's Advanced Management Instructor

PERSONAL PRODUCTIVITY

The Character-Driven Company
Five Simple Rules

BY DAVE ANDERSON

Right now, you're probably busy taking inventory, organizing your books and evaluating what you did right (and not so right) over the last 12 months in hopes of preparing yourself for a profitable new year. Here's a suggestion: Instead of focusing solely on financial matters, why not take a good hard look at the character of your company?

When you really think about it, the Ponzi schemes and shady CEO scandals that made headlines throughout 2009 boil down to a lack of solid character. Character does matter in business. Right now is a great time to sit down with your employees and define your goals for the character of your company.

Business leaders should get serious about defining what their company stands for — and share those values with their employees. It's amazing how few leaders take the time to do this. They may feel uncomfortable discussing character issues, or maybe they've never given a lot of thought to what they really stand for themselves. But just resolving to sit down and articulate your beliefs is a powerful exercise — and one that yields powerful results.

There are five simple rules that every employee, from the top of the corporate ladder on down, should follow to ensure that they have a rock-solid character.

Rule #1: Don't Tell White Lies

We're all guilty of telling a white lie or two. In fact, most of us do it on a daily basis and hardly even notice anymore! And, while we may consider those little untruths to be harmless, consider that instructing your receptionist to tell a caller that you're out of the office when you really aren't is a reflection on your own character. White lies are still lies, after all. Think of all the business scandal stories from this past year and how many of them were the result of dishonesty — and how that dishonesty shattered the lives of so many people.

White lies are like the gateway drug to bigger offenses. And, even though telling the truth is often the hard and unpopular thing to do, honesty is rule number one to developing sound character. Tell the truth because it is the right thing to do, and encourage your employees to do the same. In the end, it protects your personal integrity, and honors, rather than diminishes, everyone who hears what you have to say.

Rule #2: Keep Your Commitments

Have you ever made a business promise that you didn't keep? Perhaps you didn't follow through with a promised promotion, or skipped out early on a day when you promised to work late. And, given the past year's turbulent economy, it's even more likely that you found yourself in a situation where your mouth wrote checks in the good times that your bank account can no longer cash. Cutting expenses is necessary and understandable, but breaking promises is not — even if it turns out to be more costly, inconvenient or time-consuming than you estimated.

Don't take your promises casually and explain to your employees that they shouldn't either. This is a real test of "practicing what you preach", as your employees will be less inclined to follow this guideline if they don't see you doing the same. Before you commit to anything, make certain that you can live with the worst-case scenario resulting from what you've agreed to, and always, always follow through. Do what you said you'd do, regardless of the cost.

PERSONAL PRODUCTIVITY

Rule #3: Go the Second Mile

One of the most common character flaws in leaders and their employees is that they do only "just enough" to get by. They come to work and do just enough to get paid and just enough not to get fired. That's not good enough. Think about it this way: If the majority of people are doing only the minimum, then those who give just a little bit more of themselves will stand out and be highly valued — a great asset for any company or individual to have. So, think about what you can do to go the extra mile each day. It may mean volunteering to take on an extra project, coming in on a Saturday once in a while, or taking a night class to improve your skill set. Whatever that extra mile may be, the benefits will be well worth your sacrifice.

Some of the most successful businessmen and women will readily admit that they are no smarter than their less successful counterparts. They simply outwork them, outthink them and, as a result, outperform them. By doing what others were unwilling to do, going where they were unwilling to go, saying what they were unwilling to say, learning what they were unwilling to learn and risking what they were unwilling to risk, they earned a success and a lifestyle that the "just enough" crowd was unable to attain.

Rule #4: Don't Give False Impressions

When it comes to business, false impressions are everywhere. From misleading advertising campaigns to padded resumes, you won't be hard pressed to find examples of people trying to make others believe things are better than they really are. You have to be upfront and honest with those you work with, or you may lose your credibility and build up bitterness and resentment in a once-valuable business relationship. Think about the ways that you or your company may be misleading others, and find ways to stop them.

There are a few simple things you can do to get your employees and organization on the road to transparency. For starters, stop any misleading advertising you may be engaged in, and remember — if you're not sure if it's misleading, then it probably is! Make sure that you aren't spinning feedback to make someone feel as though they're doing better or worse than they really are. And certainly don't mislead any potential job candidates or employees about realities concerning compensation, advancement or future plans. Cultivating a culture of honesty in your organization will only bless your business.

Rule #5: Reconcile and Forgive Immediately

Holding grudges is a common and unfortunate consequence of competitive business. Resentment builds up when employees leave organizations, when mistakes are made or when coworkers feel slighted. This is an appropriate time of year to take inventory of any grudges you're nursing, people you're resenting and those with whom you must reconcile. It doesn't matter how far back the offense was — if you're carrying it around, it's affecting your performance whether you realize it or not. Suggest to your employees that they think about any hard feelings they may be harboring from the past year, and encourage them to make amends.

When you are busy harboring resentment and holding onto grudges, you are taking time and precious energy away from the things you could be doing to increase your productivity and your business. Bring closure to past offenses. Identify amends you must make and with whom, and do it quickly. By holding onto these hard feelings, you aren't hurting the other person — you're hurting yourself! And, having a clear conscience and a sound heart is a key component to having a solid character.

Conclusion

Still skeptical about your ability to pull this off — not to mention how well received it's likely to be? Just give it a try. You'll be pleasantly surprised by the results. But, if you can't bring yourself to discuss these matters openly, just living them sends a persuasive message.

It's one thing to sit down with your employees and share your values, but the best way to get the message across is to make sure that you are setting the example yourself. You have to walk the walk. If you haven't been doing so, make a point to change that in 2010. Others in your organization will be sure to follow. And, you'll see firsthand that a business that is based on strong core values and a shared vision is one that's headed for long-term success and prosperity. BP

About the Author:

Dave Anderson is president of Dave Anderson's Learn to Lead and has given over 1,000 leadership presentations in thirteen countries. He is the author of ***If You Don't Make Waves, You'll Drown; Up Your Business!; How to Deal with Difficult Customers and the TKO*** *business series, all from Wiley. He and his wife, Rhonda, are cofounders of The Matthew 25.35 Foundation, which helps feed, educate and house destitute people throughout the world.*

For more information, please visit www.learntolead.com.

About the Book:

How to Run Your Business by THE BOOK: A Biblical Blueprint to Bless Your Business *(Wiley, 2009, ISBN: 978-0-4704964-2-8, $24.95) is available at bookstores nationwide, major online booksellers or directly from the publisher by calling 800-225-5945. In Canada, call 800-567-4797.*

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR(S)	LOCATION	DATE	INFORMATION
Compressed Air Challenge® Fundamentals of Compressed Air Systems	MREA Great River Energy	Maple Grove, MN	2/11/10	Shari Wormwood Tel: 763-424-7231 email: shari@mrea.org www.compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Compressed Air Challenge®	Online Web Training	2/22/10	Register by Feb. 8, 2010 Tel: 301-751-0115 www.compressedairchallenge.org
Compressed Air Challenge® Advanced Mgmt of Compressed Air Systems	Massachusetts Energy Efficiency Partnership National Grid	Waltham, MA	2/22/10	Mark Gerrish Tel: 413-545-2853 email: mfgerrish@ecs.umass.edu www.compressedairchallenge.org
Intro to Compressed Air Systems	Association of Energy Engineers Globalcon 2010	Philadelphia, PA	3/22/10	Gary Wamsley Tel: 678-977-1508 email: gary.wamsley@comcast.net

Editors' Note: If you conduct compressed air system training and would like to post it in this area, please email your information to rod@airbestpractices.com.

INDUSTRY NEWS

Independent Testing Verifies the Performance of Ingersoll Rand Compressed Air Dryers

Ingersoll Rand's refrigerated dryers have been verified against CAGI (Compressed Air and Gas Institute) data sheets by independent third-party testing. Based on this testing, the refrigerated dryers are now certified by CAGI. Of the many dryer manufacturers that have participated in this verification process, Ingersoll Rand is one of only three to receive the CAGI certification. The certification means that Ingersoll Rand dryers perform exactly to the standards the company publishes. Certification is an assurance that an Ingersoll Rand dryer will meet the users' intended performance.

The verification of the product was done through CAGI's Performance Verification Program. During the testing, energy consumption, pressure drop and pressure dew point are compared with data provided by Ingersoll Rand on standardized data sheets available from CAGI. The program applies to stand-alone type refrigerated dryers with 200–1,000 standard cubic feet per minute (scfm) capacities. The program is available to all manufacturers of refrigerated compressed air dryers, regardless of whether they are a CAGI member of not.

The CAGI program provides a means for users to assess and compare brands and models before purchasing, and eliminates the need for interpretation of non-standard data. Because Ingersoll Rand units perform in accordance with the information on the data sheets, they are certified to carry the official CAGI Performance Verification Program label. Ingersoll Rand is one of the few dryer manufacturers to receive this certification.

Compressed air users are invited to view the data sheets for air dryers at www.ingersollrandproducts.com, or contact their local Ingersoll Rand representative for information.

RESOURCES FOR ENERGY ENGINEERS

PRODUCT PICKS

Free Energy Evaluation

Kaeser is extending the Kaeser Energy Saving System (KESS) program into 2010 — and still at no cost. With a no-obligation KESS assessment, your local Kaeser representative conducts a walkthrough at your location and completes a detailed questionnaire on your air system. Kaeser engineers use the information to create a custom report describing energy- saving opportunities, including two energy-saving scenarios. Within days, you receive the report to help you in quick decision-making and long-term planning for reducing energy consumption and cost.

Kaeser Compressors
Tel: 866-958-6800
www.kaeser.com/kess

New Wireless Monitoring System

Boge America has just introduced Logair, a wireless communication system that provides remote monitoring of a compressed air system via either a PC or cell phone. Boge Logair is the ideal solution when a user wants a permanent on-line link that provides a remote data request system and visualization over the Internet, without the necessity of a comprehensive management system.

The Boge Logair is easily installed into a compressor. It can then be programmed via a PC or laptop. Fault messages can be easily transmitted via SMS to a chosen cell phone, and the data, messages and all controller information can be accessed via an Internet connection.

Boge America
Tel: 770-874-1570
www.boge.com/us

New Dew Point Transmitter

Kahn Instruments announces the new Easidew PRO I.S. Dew Point Transmitter. The Easidew PRO I.S. is a ruggedized version of the intrinsically safe Easidew I.S. Transmitter, and is designed for continuous measurement of moisture content of gases in hazardous-area applications typically found in natural gas, petrochemical and process industries. Key features include:

- Heavy duty, process-type NEMA 4/IP66, weatherproof, stainless steel housing with ½" NPT conduit entry fitting
- FM/CSA Certified for Class I, Div. 1, Groups A, B, C & D T4 hazardous location use
- 2-wire, loop-powered, 4–20 mA linear, analog output
- Output configurable in °F or °C dew point or PPMv moisture content (0–100, 0–1000 and 0–3000 PPMv ranges)
- Operating pressure up to 5000 psig

The Easidew PRO I.S. Transmitter has a dew point measurement range of -148 °F to 68 °F, accuracy of ±3.6 °F and operates from any 12–28 VDC power source.

Kahn Instruments
Tel: 860-529-8643
Email: hygros@kahn.com
www.kahn.com

LITERATURE & SERVICES PICKS

The Compressed Air System Solution Series©

Scot Foss has provided his expertise to many of the world's leading manufacturing and processing corporations by finding solutions to their problems. Foss is one of the world's leading experts in compressed air systems, known for his sometimes-controversial approach to the issues that face plant engineers, maintenance managers and production engineers.

Written in a conversational format, this 1,100-page book with 165 illustrations brings you solutions with a straight on, common sense approach supported by technology. The author focuses on concepts and applications, which are guaranteed to improve production results and energy efficiency. The chapters of the book are as follows:

1. Change Your Way of Thinking about Compressed Air
2. Designing a New System
3. Troubleshooting the System
4. Instrumentation and Information Management
5. Compressed Air Storage and Using Potential Energy
6. Piping and Piping Systems
7. Compressor and System's Controls
8. The Business of Demand
9. Supply Energy
10. Cleaning Up Compressed Air
11. Standards and Specification

The cost of the book is $195.99. To order the book, make a check or PO out to: Air's a Gas, Inc., 3728 Berenstain Drive, St. Augustine, FL 32092, or call 904-940-6940, fax 904-940-6941 or e-mail: airsagas@aol.com. A portion of the proceeds from this book will be donated to selected children's charities.

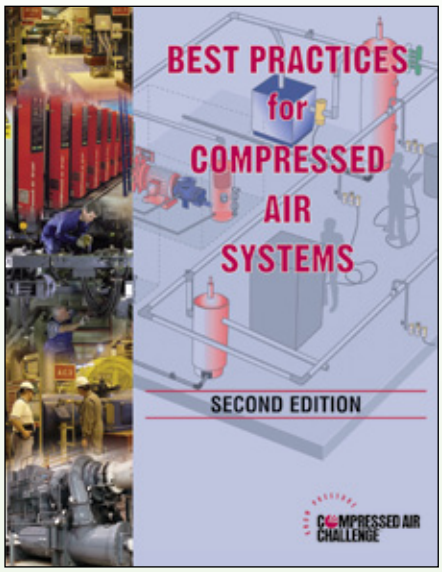
New Edition of "Best Practices for Compressed Air Systems®" from the Compressed Air Challenge®

The Compressed Air Challenge® has released the Second Edition of their authoritative "Best Practices for Compressed Air Systems®."* The Best Practices manual provides tools needed to reduce operating costs associated with compressed air and to improve the reliability of the entire system. The 325-page manual addresses the improvement opportunities from air entering the compressor inlet filter, through the compressor and to storage, treatment, distribution and end uses, both appropriate and potentially inappropriate. Numerous examples of how to efficiently control existing and new multiple compressor systems are provided in one of the many appendices.

The Best Practices manual created by the Compressed Air Challenge® begins with the considerations for analyzing existing systems or designing new ones. The reader can determine how to use measurements to audit their own system, how to calculate the cost of compressed air and even how interpret electric utility bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment are included in each section. BP

**The Best Practices for Compressed Air Systems® manual is a product of the Compressed Air Challenge®, co-authored by Bill Scales and David McCulloch and is not associated with Compressed Air Best Practices® Magazine.*

Compressed Air Challenge®
www.compressedairchallenge.org



WALL STREET WATCH

BY COMPRESSED AIR BEST PRACTICES®

The intent of this column is to provide industry watchers with publicly held information, on publicly-held companies, involved with the sub-industry of compressed air. It is not the intent of the column to provide any opinions or recommendations related to stock valuations. All information in this column was at the close of the trading day of January 22, 2010.

JANUARY 22, 2010 PRICE PERFORMANCE	SYMBOL	OPEN PRICE	1 MONTH	6 MONTHS	12 MONTHS	DIVIDEND (ANNUAL YIELD)
Parker-Hannifin	PH	$57.62	$54.81	$48.14	$38.85	1.74%
Ingersoll Rand	IR	$35.24	$36.29	$27.31	$16.61	1.42%
Gardner Denver	GDI	$41.01	$43.37	$29.69	$21.31	0.49%
United Technologies	UTX	$69.08	$70.46	$52.11	$48.67	2.33%
Donaldson	DCI	$40.41	$43.55	$38.20	$30.72	1.14%
SPX Corp	SPW	$56.74	$56.90	$55.06	$44.30	1.76%

Donaldson Reports First Quarter Results and Increases Outlook

Donaldson Company, Inc. (NYSE: DCI) announced its financial results for its first quarter ended October 31, 2009.

Summarized financial results for the period ended October 31 are as follows (dollars in millions, except per share data):

	THREE MONTHS ENDED OCTOBER 31, 2009		
	2009	2008	CHANGE
Net Sales	$428.1	$573.3	-25.3%
Operating Income	52.4	69.7	-24.7%
Net Earnings	34.6	48.0	-27.9%
Diluted EPS	$0.44	$0.60	-26.7%

Included in the above results are pre-tax restructuring expenses of $1.3 million, which reduced EPS by $0.01. Excluding the impact of these restructuring expenses, EPS was $0.45.

"While our year-over-year comparisons were negative as we were up against last year's record first quarter sales and earnings, our first quarter results were better than our expectations," said Bill Cook, chairman, president and CEO. "We expect the year-over-year comparisons to be negative again in our second quarter, as the recession began to impact us midway through last year's second quarter. However, we expect the rate of decrease will be less. With the gradual forecasted improvement in our overall business conditions, we expect the second half of FY10 comparisons versus last year will be positive.

"We are very happy to report that for the second consecutive quarter our sales were up on a sequential basis. A number of our end markets have improved and, while some other later-cycle end markets are still declining, our overall sales level is now beginning to recover. Our Engine Products sales were up 7% from the fourth quarter of FY09 due to higher sales in Aftermarket Products, On-Road Products and Off-Road Products. Our Industrial Products sales were down 5% sequentially, although our Special Applications Products sales were up, due to an improvement in the hard disk drive market.

"Although our Customer sales levels remain significantly impacted by the ongoing global recession, I am very proud at how well we are running our Company. Our focus has been on managing what we can control in this very turbulent economic environment.

"By focusing on what we can control, we have been very successful as our operating margin of 12.3% increased from last year's record first quarter of 12.2%. We benefited from the savings generated by our restructuring activities and our ongoing product and process cost reduction initiatives. These savings helped offset lower absorption of fixed costs in our manufacturing plants. Our sales mix also helped deliver improved margins as our total replacement filter sales exceeded our first-fit sales for the first time.

"We also continued to focus on improving our balance sheet. We have again improved our already-strong liquidity position, as we generated free cash flow of $62 million in the first quarter. This has allowed us to continue to invest in our business for the future and reduce debt by another $6 million, while still increasing our international cash reserves and maintaining our dividend. With our continued strong cash flow, we also resumed our long-standing share repurchase program during the quarter."

"We are very happy to report that for the second consecutive quarter our sales were up on a sequential basis. A number of our end markets have improved and, while some other later-cycle end markets are still declining, our overall sales level is now beginning to recover."

**— Bill Cook,
Chairman, President and
CEO of Donaldson Company, Inc.**

WALL STREET WATCH

"We are pleased to see that our efforts to increase customer focus, strengthen the aftermarket and reduce costs are paying off in these difficult market conditions"

— Ronnie Leten, President and CEO of the Atlas Copco Group

Atlas Copco's 3rd Quarter Results

Atlas Copco achieved a healthy profitability in the third quarter, supported by sales of aftermarket products and services and continued efficiency improvements. While demand for equipment remained low in most regions, all business areas increased their profitability compared to the second quarter.

"We are pleased to see that our efforts to increase customer focus, strengthen the aftermarket and reduce costs are paying off in these difficult market conditions," says Ronnie Leten, president and CEO of the Atlas Copco Group. "We have now achieved annual savings of more than MSEK 2 000."

Commenting on the near-term outlook, Ronnie Leten says: "Overall demand is expected to stay around the current level. The demand in some emerging markets, including China and India, is expected to gradually improve." Revenues in the third quarter fell 18% to MSEK 15 088, an organic decline of 25%. Organic order intake dropped 30%. Operating profit was MSEK 2 402, corresponding to a margin of 15.9% (19.7% a year earlier and 12.8% in the second quarter). Demand remained stable on a lower level than the previous year, but some emerging markets noted improved demand during the quarter compared to the beginning of 2009.

"Even with the changes we have done, overall efficiency is not yet at the level we believe it can be. We have to improve organizational efficiency, but at the same time invest in sales and service people," Ronnie Leten says. "We must make sure we are visiting all potential customers with a constant flow of new products and services."

Products launched during the third quarter included oil-free compressors for sensitive applications like hospitals, radio remote controlled surface drill rigs and ergonomically designed sanders. BP

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Tel: 251-680-9154

Subscriptions & Administration: Patricia Smith
patricia@airbestpractices.com
Tel: 251-510-2598
Fax: 412-831-3091

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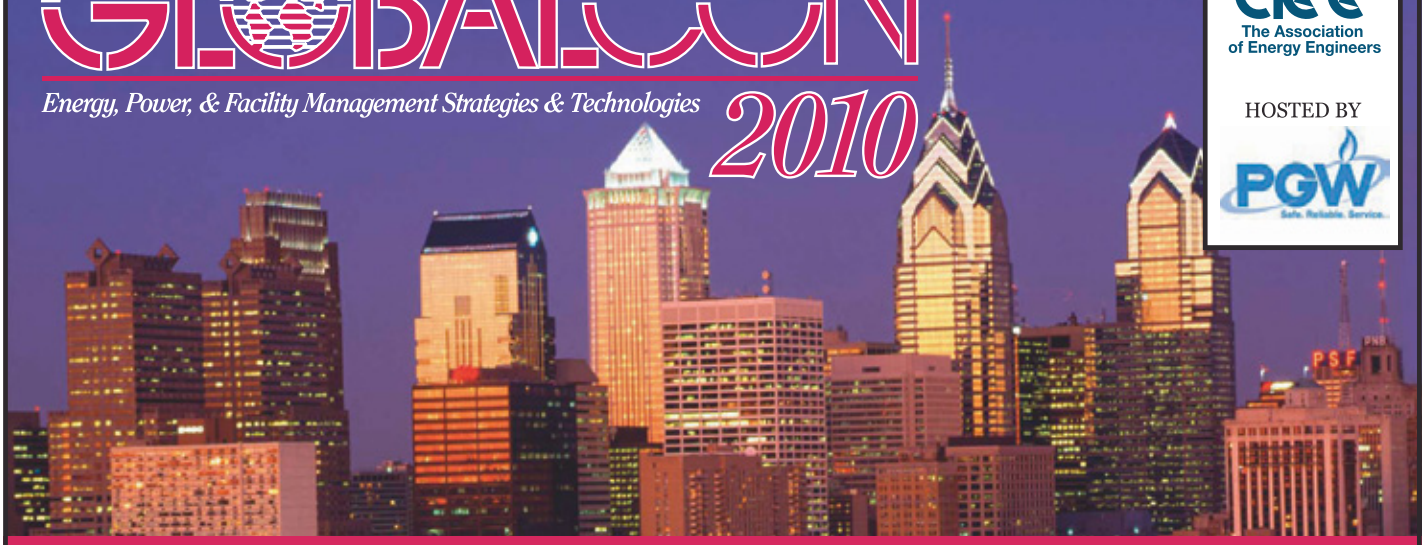

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