

## **High-Bleed Pneumatic Devices**

### **Program Description**

This strategy to reduce ambient ozone levels within the non-attainment area (NAA) considers changes that can be made by industry regarding high-bleed pneumatic devices. Colorado Air Quality Control Commission Regulation No. 7 (Reg. 7) may be modified to require that natural gas exploration and production (E&P) and mid-stream facilities within the NAA reduce emissions from high-bleed pneumatic devices in one or more of the following ways:

- Require that new facilities install low- or no-bleed pneumatic devices
- Require that existing facilities retrofit or replace high-bleed pneumatic devices with low- or no-bleed pneumatic devices
- Require that enhanced maintenance be performed on high-bleed pneumatic devices
- Require keeping natural gas actuated device discharge from being vented
- Require using an instrument air system
- Require using solar generated electricity at E&P sites

Many process control devices are used to operate valves that regulate pressure, flow, temperature, and liquid levels. These devices can be operated pneumatically, electrically, or mechanically. Most of the devices used by the natural gas industry are pneumatically operated. Although instrument air is commonly used to power pneumatic devices at gas processing facilities, the majority of natural gas industry pneumatic devices are powered by natural gas.<sup>1</sup> Other uses of pneumatic devices occur with small pumps, compressor motor starters, and isolation shutoff valves.

As part of normal operation, most pneumatic devices release, or “bleed”, gas to the atmosphere either continuously or intermittently. A 2003 Environmental Protection Agency (EPA) study reported that emissions from pneumatic devices are collectively one of the largest sources of methane emissions in the natural gas industry. Estimated annual nationwide methane emissions are approximately 31 billion cubic feet (Bcf) from the production sector, 16 Bcf from the processing sector, and 14 Bcf from the transmission sector.<sup>1</sup> By definition, high-bleed pneumatic devices emit at least 6 standard cubic feet gas per hour (scfh) to atmosphere. One company determined that pneumatic devices were emitting an average of 35 scfh.<sup>2</sup> Natural gas is composed primarily of methane, but also contains other compounds including volatile organic compounds (VOCs) and hazardous air pollutants (HAPs).

### **Install, Retrofit, or Replace to Low- or No-Bleed Pneumatic Devices**

Many companies have reduced natural gas emissions significantly by replacing or retrofitting high-bleed pneumatic devices. Field experience shows that up to 80 percent of all high-bleed devices can be replaced or retrofitted with low-bleed equipment.<sup>1</sup> The retrofit or replacement of devices can provide better system-wide performance and reliability, and improve monitoring of parameters such as gas flow, pressure, and liquid level.

### **Perform Enhanced Maintenance or Keep Discharge From Being Vented**

Up to 20 percent of high-bleed devices can not be retrofitted or replaced with low-bleed devices. For example, very large devices require fast and/or precise responses to process changes which can not be achieved with low-bleed devices. In those cases, natural gas emissions can be reduced by routing pneumatic discharge into a fuel gas supply line or a closed loop controlled system and to a lesser extent, by performing enhanced maintenance. In order to route the natural gas into a fuel gas supply line, it may be necessary to pressurize the gas. Enhanced maintenance includes cleaning, tuning, and repairing leaking gaskets, tubing fittings, and seals.

### **Use Instrument Air System**

Instrument air systems are typically installed at facilities that have a high concentration of pneumatic devices, full-time operator presence, and are on a power grid. In an instrument air system, atmospheric

air is compressed, stored in a volume tank, filtered, and dried for instrument use. Pneumatic device operation is the same whether they are powered by air or natural gas. Existing pneumatic gas supply piping, control instruments, and valve actuators can be reused when converting to compressed air systems.

#### Use Solar Generated Electricity

E&P sites are not usually on a power grid, so it is generally not practical to power pneumatic devices with instrument air. However, pneumatic devices can be powered by solar generated electricity. The power supply consists of solar panels and batteries. Electro-pneumatic devices use weak electric current instead of the gas stream to signal pneumatic valve actuation. Due to advances in technology, the use of electronic control instrumentation is increasing.<sup>1</sup>

#### **Air Quality/Health and Welfare Benefits**

A preliminary estimate of pneumatic device VOC emissions (including pumps) is approximately 13,000 tons per year in the NAA.<sup>3</sup> To calculate potential VOC emission reductions that may be obtained by implementing this strategy, it will be necessary to determine how many pneumatic devices are used, average or estimated bleed rates for each type per unit of natural gas produced, and the natural gas content. Basin-wide emissions can be estimated by scaling up estimates from a single valve or single well by the total gas production. Some of this information was provided in the Independent Petroleum Association of Mountain States (IPAMS) February 2008 report.

While health benefits are not quantified here, it is understood that reducing direct emissions of VOCs will reduce air toxics and other criteria pollutants. This will reduce the incidence of human health impacts caused by pulmonary, cardiovascular, respiratory, and nervous system disease. Because ozone damages crops, forests, and other natural plant life, all would benefit if emissions are reduced. This strategy would also reduce emissions of methane, which contributes to climate change.

#### Install, Retrofit, or Replace to Low- or No-Bleed Pneumatic Devices

When high-bleed pneumatic devices are replaced with or retrofitted to low- or no-bleed devices, natural gas emissions to atmosphere are reduced approximately 88 or 98 percent, respectively.<sup>4,5</sup> Companies have reported to EPA that they have reduced methane emissions by 45-260 thousand cubic feet (Mcf) per year per pneumatic device.<sup>1</sup>

Anadarko Petroleum Corporation (formerly Kerr-McGee Corporation) estimates that VOC emissions from their pneumatic devices will be reduced by 464 tpy once 548 of their pneumatic controllers are retrofitted in Colorado. This project is scheduled to be completed by May 2008.

#### Perform Enhanced Maintenance

Cleaning, tuning, and repairing leaking gaskets, tubing fittings, and seals can reduce natural gas emissions from each device by 5 to 10 scfh. Tuning to operate over a broader range of proportional band often reduces emissions by as much as 10 scfh. Eliminating unnecessary valve positioners can reduce emissions from each device by up to 18 scfh.<sup>1</sup>

#### Keep Discharge From Being Vented

Almost 100 percent of natural gas emissions would be eliminated if discharge from pneumatic devices is routed into a fuel gas supply line or a closed loop controlled system instead of being vented to atmosphere.

#### Use Instrument Air Rather than Methane

100 percent of natural gas emissions would be eliminated from pneumatic devices if instrument air, rather than natural gas, was used to power them. However, NOx and CO emissions would be generated by the air compressor needed for the instrument air system, unless the compressor is electrically-powered.

Companies have reported reducing methane emissions by an average of 20 Bcf per year per facility when they convert to instrument air.<sup>6</sup>

#### Require Solar Generated Electricity

Natural gas emissions are eliminated for each pneumatic device that is replaced with a solar generated electricity powered device. The overall reduction at each E&P site depends on the number and bleed rate of pneumatic devices and the size of pneumatic pumps that are being replaced.

#### Program Costs

EPA Natural Gas STAR partners have achieved significant savings and emissions reductions through replacement, retrofit, and maintenance of high-bleed pneumatic devices. Most retrofit investments pay for themselves in approximately one year, and replacements in as little as 6 months.<sup>1</sup>

#### Install, Retrofit, or Replace to Low- or No-Bleed Pneumatic Devices

The EPA reports that one company replaced 70 high-bleed pneumatic devices with low-bleed devices and retrofitted 330 high-bleed devices, which resulted in an emission reduction of 1,405 thousand cubic meters (Mcm) per year. At \$105 per Mcm, this resulted in a savings of \$148,800 per year. The cost, including materials and labor for the retrofit and replacement, was \$118,500. Therefore, the payback period was less than one year.<sup>7</sup>

Early replacement (replacing prior to projected end-of-service-life) of a high-bleed valve with a low-bleed valve is estimated to cost \$1,350. Based on \$3 per Mcf gas, the payback is estimated to take 21 months. For new installations or end of service life replacement, the incremental cost difference of high-bleed devices versus low-bleed devices is \$150 to \$250. Based on \$3 per Mcf gas, the payback is estimated to take 5 to 12 months.<sup>1</sup>

#### Perform Enhanced Maintenance

Enhanced maintenance of pneumatic devices, which consists of cleaning, tuning, and repair or replacing leaking gaskets, tubing fittings and seals, is estimated to cost up to \$350. Based on \$3 per Mcf gas, the payback is estimated to take 0 to 5 months.<sup>1</sup>

#### Keep Discharge From Being Vented

To be determined.

#### Use Instrument Air System

It is cost effective to convert gas pneumatic devices to instrument air if the site has available electrical power. Several companies have reported to the EPA that by converting, they have saved an average of 20,000 Mcf methane per year, thus saving an average of \$60,000 (based on \$3 per Mcf gas). Because the average cost of implementation was \$50,000 per year, the average payback was less than one year, and as little as 4 months.<sup>8</sup>

#### Require Solar Generated Electricity

This strategy reduces natural gas consumption, which increases the amount of natural gas in the sales line. The solar systems minimize the requirement for expensive fuel gas regulators, shutdown devices, repair kits, and stainless steel instrument tubing and fittings.<sup>9</sup>

#### Implementation/Administration

This strategy has the potential to significantly increase the number of regulated sources, and has reporting, permitting, and/or compliance assurance impacts to the APCD.

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<sup>1</sup> US EPA, *Lessons Learned: Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry*

<sup>2</sup> Targa Resources and the Gas Processors Association, *Directed Inspection and Maintenance (DI&M) at Gas Processing Plants*, presented July 27, 2006 at Hobbs, New Mexico

<sup>3</sup> ENVIRON, Buys and Associates, and IPAMS, *Development of Baseline 2006 Emissions from Oil and Gas Activity in the Denver-Julesburg Basin*, February 7, 2008

<sup>4</sup> Roger Fernandez, Robin Petrusak, Donald Robinson, and Duane Zavadil, *Cost-Effective Methane Emissions Reductions for Small and Midsize Natural Gas Producers*, reprinted from the June 2005 issue of *Journal of Petroleum Technology*

<sup>5</sup> ENVIRON, *WRAP Area Source Emissions Inventory Projections and Control Strategy Evaluation Phase II Final Report*, September 2007

<sup>6</sup> Four Corners Air Quality Task Force, *Four Corners Air Quality Task Force Report of Mitigation Options, Mitigation Option: Convert Gas Pneumatic Controls to Instrument Air*, November 1, 2007

<sup>7</sup> US EPA, *Methods for Reducing Methane Emissions from Natural Gas Systems*, [www.coalinfo.net.cn/coalbed/meeting/2203/papers/naturalgas/NG019.pdf](http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/naturalgas/NG019.pdf)

<sup>8</sup> US EPA, *Lessons Learned: Convert Gas Pneumatic Controls to Instrument Air*

<sup>9</sup> Four Corners Air Quality Task Force, *Four Corners Air Quality Task Force Report of Mitigation Options, Mitigation Option: Solar Power Driven Wellsites and Tank Batteries*, November 1, 2007