High-Bleed Pneumatic Devices

Program Description

This strategy to reduce ambient ozone levels by reducing volatile organic compounds (VOCs) within the non-attainment area (NAA) considers changes that industry can make 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 by incorporating one or more of the following options:

- 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.[1] Other uses of pneumatic devices occur with small pumps, compressor motor starters, and isolation shutoff valves.

As part of normal operation, most pneumatic devices emit, 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.[1] By definition, high-bleed pneumatic devices emit at least 6 standard cubic feet gas per hour (scfh) to atmosphere. The highest bleed rate listed in one source, a table published by the EPA, is 42 cubic feet per hour (cfh).[1] The average bleed rate for high-bleed pneumatic devices in the NAA is 21 cfh.[2] Natural gas is primarily composed of methane, but also contains other compounds including VOCs and hazardous air pollutants (HAPs). Bleed rates of 6, 21, and 42 cfh natural gas represent emission sources of 0.3, 1.1, and 2.1 tons per year (tpy) VOC, respectively, assuming a VOC molar fraction of 7.47 percent, which is representative of the NAA.[2]

Options for Further Consideration

VOC emissions from pneumatic devices within the NAA were 24.8 tons per day (tpd) for the 2006 baseline and have been projected to be 28.6 tpd for the 2010 baseline. These emissions represent 14.0 and 15.1 percent of the total VOC emissions from oil and gas sources in the NAA in 2006 and 2010, respectively.[3] Therefore, emission reductions related to this source category have the potential to be significant. As a result, this strategy has been developed since the draft version was presented at the February 26, 2008 RAQC stakeholder meeting. However, not all options within this strategy have been further developed. This paper presents information for the options that have been further developed.

All stakeholder comments received to date and responses, if ready, are available in a separate document that will be accessible to stakeholders.

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 devices.[1] Retrofitting or replacing 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
Up to 20 percent of high-bleed devices can not be retrofitted or replaced with low-bleed devices.[1] 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 may be reduced by performing enhanced maintenance. Enhanced maintenance includes cleaning, tuning, and repairing leaking gaskets, tubing fittings, and seals. Additional enhanced maintenance includes tuning to operate over a broader range of proportional band and eliminating unnecessary valve positioners.

Air Quality

VOC emissions from pneumatic devices within the NAA were 24.8 tpd for the 2006 baseline. They have been projected to be 28.6 tpd for the 2010 baseline, assuming that regulatory and industry policy and practices do not change.[3] VOC emissions may be reduced by 16.2 tpd if the first and second options presented in this strategy are adopted (low- or no-bleed devices are used instead of high-bleed devices in most instances). If the third option is adopted, VOC emissions would be reduced by an additional 1.3 tpd (enhanced maintenance performed on high-bleed devices that can not be retrofitted or replaced with low- or no-bleed devices).

These emission reduction values are based upon the following assumptions.

- 80 percent of high-bleed devices can be converted to low- or no-bleed devices[1]
- The average bleed rate for low- and no-bleed devices is 1.934 cfh[2]
- Enhanced maintenance will be performed on remaining high-bleed devices (20 percent of original number)
- Enhanced maintenance consists of cleaning, tuning, and repairing leaking gaskets, tubing fittings, and seals
- Enhanced maintenance will reduce emissions from high-bleed devices by 7.5 cfh per device[1]

Health and Welfare Benefits

While health benefits are not quantified here, it is understood that reducing direct emissions of VOCs can reduce ozone and some air toxics. This will reduce the incidence of human health impacts caused by ozone such as pulmonary, cardiovascular, respiratory, and nervous system disease. Because elevated ozone also 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.

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.[1]

A cost analysis was performed based on assumptions described in the Air Quality section of this paper over a time period of 1 year. Results are shown in the following table. Costs depend on whether high-bleed devices are converted to low- or no-bleed devices by retrofitting, replacing at end-of-service life, or early replacement and also whether or not enhanced maintenance is performed on remaining high-bleed devices.

Option	***Cost per Device[1]***	***Cost with Enhanced Maintenance ($/ton VOC)****	***Cost without Enhanced Maintenance ($/ton VOC)****
Retrofit 80 % High-Bleed to Low-/No-Bleed	$500	376	373
Replace 80 % High-Bleed to Low-/No-Bleed at End-of-Life	$250	203	186
Early Replacement 80 % High-Bleed to Low-/No-Bleed	$1350	962	1,007
Perform Enhanced Maintenance on 20% High-Bleed	$176***	NA	409 **

* Reported costs of reducing VOCs are higher than actual costs because the calculations do no include income that will be generated by reduced product (natural gas) loss

** Cost to perform enhanced maintenance without considering other options is $409 per ton VOC reduced

*** The cost per device to perform enhanced maintenance is made up of the cost to reduce the supply pressure ($153) and the cost to repair leaks and retune ($23)

<u>Install, Retrofit, or Replace to Low- or No-Bleed Pneumatic Devices</u>
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.[4]

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.[1]

<u>Perform Enhanced Maintenance</u>
Enhanced maintenance of pneumatic devices, which nominally 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.[1]

<u>**RACT Considerations**</u>

In conjunction with the first and second option presented in this strategy, the Colorado Air Pollution Control Division (APCD) is proposing to make Reasonably Available Control Technology (RACT) consistent between Reg. 3 and Reg. 7 to address the potential conflict between the regulations on when RACT is triggered. Reg. 3 triggers RACT at permit levels for new sources, whereas Reg. 7 triggers RACT by source category or at 100 tpy (as described in Section II.c.1.a(1)). This could be accomplished by removing Reg. 7 language regarding RACT and other applicable exemptions and instead relying upon existing Reg. 3 language or by making Reg. 7 language consistent with Reg. 3 language. General concepts associated with the presumptive RACT proposal are:

- The regulation should be modified to establish that the APCD will require RACT for all new and modified oil and gas sources
- Wyoming Best Available Technology (BAT) determinations can be used as an example, which will reduce APCD resource impacts to initiate the program. Over time, the APCD would re-evaluate RACT determinations to ensure requirements utilize current control technology. The goal may be a review of each technology and update as needed. All RACT policies would be available on the Web, which would promote consistency.

- RACT determinations can be identified by compiling and maintaining a list in a guidance document, rather than in regulation, so that they can be modified more easily to keep with current technology.
- The APCD may consider developing general permits that would include the relevant RACT determination to streamline the permitting process.
- RACT applies to new and modified sources. The APCD may need to address existing sources to ensure ozone is reduced to National Ambient Air Quality Standards (NAAQS).

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.

References

[1] US EPA, *Lessons Learned: Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry*
[2] ENVIRON, Buys and Associates, and IPAMS, *Development of Baseline 2006 Emissions from Oil and Gas Activity in the Denver-Julesburg Basin*, February 7, 2008
[3] ENVIRON, Buys and Associates, and IPAMS, *Development of Baseline 2006 Emissions from Oil and Gas Activity in the Denver-Julesburg Basin*, March, 2008
[4] US EPA, *Methods for Reducing Methane Emissions from Natural Gas Systems*, www.coalinfo.net.cn/coalbed/meeting/2203/papers/naturalgas/NG019.pdf

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