



### 3.2.2. High to Low Bleed Instrumentation Conversion Projects

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#### Description

Across the upstream oil and gas industry, instrumentation is used to take measurements and control processes, typically by sending a signal to a valve to adjust its position based on changes in the process conditions. In pneumatic control systems, pressure (in the form of compressed gas) provides the energy source for process control. Common process-control devices include liquid level controllers, temperature controllers, pressure controllers, pressure regulators, switches and valve controllers (e.g. positioners or transducers).

In general, most pneumatic controllers are set to operate with supply pressures of either 20 pounds per square inch (psig) (for a 3-15 psig signal) or 35 psig (for a 6-30 psig signal), depending on the instrument design. Some larger emergency shut-down valves (ESDVs) may operate at 80 to 100 psig. Devices that operate at higher pressures will vent more gas.

In broad terms, there are three types of pneumatic devices:

- Continuous bleed devices are used to modulate flow, liquid level, or pressure, and will generally vent gas at a steady rate. These devices are used for throttling control and in situations where fast responses are required, such as flow- or pressure-control.
- Intermittent bleed or actuating bleed devices perform snap-acting or on/off-type control, and vent gas only when they stroke a valve open or closed or when they throttle gas flows. Examples of intermittent bleed controllers include certain liquid-level controllers or controllers used for ESDVs.
- No-bleed devices are non-emitting devices such as self-contained devices that vent into the downstream pipeline or other devices that are driven by compressed air. Non-pneumatic devices that rely on electricity or hydraulics may also be referred to as no-bleed devices.

It is common to define controllers as either “high-bleed” or “low-bleed”, where high-bleed controllers are those that vent more than six standard cubic feet per hour (scfh) and low-bleed devices vent less than that threshold. It is important to note that manufacturers usually only specify the steady-state bleed rate and not the dynamic bleed rate associated with valve actuations. Both continuous and intermittent devices can be high-bleed, depending on the device type and process conditions (e.g. frequency of valve actuations).

The conversion from a high-bleed controller to a low-bleed controller can be achieved either by replacing the existing controller or by installing a retrofit kit. Both types of projects will reduce venting of natural gas. A third alternative is to remove from service the high-bleed controllers that are no longer needed to safely operate the process; however, the feasibility of removing controllers is more site-specific.

Baseline:

The baseline for a high to low bleed project is the venting of natural gas or “instrument gas” (containing primarily methane) to the atmosphere from dedicated vent lines associated with the operation of pneumatic controllers. Flaring of instrument gas is not normally practiced for safety and operational reasons (E.g. to prevent backpressure on the instruments).



Throughout the oil and gas industry it is standard practice to use pressurized natural gas to operate pneumatic instruments in process control applications. Once the natural gas has run through the instrument or through the instrumentation loop, it is vented to the atmosphere, resulting in lost natural gas that could have otherwise been directed to sales, as well as greenhouse gas (GHG) emissions. Methane is a potent GHG, with a global warming potential (GWP)<sup>1</sup> of 25 times that of carbon dioxide. Due to the simplicity and reliability of pneumatic instrumentation as well as the lack of available electricity in many locations, pneumatic instrumentation continues to be the standard in the oil and gas industry.

## Technology Group

Wellsite and Upstream Facilities Instrumentation and Controls – Recommended Practices

### Site Applicability

The first step in identifying potential retrofit opportunities is to collect an inventory of pneumatic controllers either across an operating region or for an entire producing field. Completing field-wide retrofit programs helps to achieve economies of scale, which are important in spreading out the transportation and logistics costs associated with retrofit programs.

The next step is to prioritize the sites with known high-bleed controllers such as Fisher 4150 pressure controllers, Fisher 546 transducers, and Fisher 2500 and 2900 level controllers, among others. Typical bleed rates for both high- and low-bleed devices are outlined in the references<sup>2</sup> section of this document.

When evaluating retrofit projects, it is important to confirm that the existing high-bleed controller is necessary. In some cases, it may be possible to completely remove existing high-bleed controllers from service. This is usually the most economical solution. In other cases, a throttling controller can be replaced with a snap-acting controller, such as when a flow controller is replaced with an on/off solenoid for older gas wells that build up pressure and flow intermittently (e.g. using timers or plunger lifts).

If the existing controller is in poor condition, the best option is to install a new low-bleed controller rather than a retrofit kit (e.g. for a Fisher 4150 retrofit, a new low bleed C1 controller should be selected instead of a Mizer kit).

## Emissions Reduction and Energy Efficiency

Estimated Gas Savings:

Determining the potential gas savings and GHG reductions from a high to low bleed conversion project is relatively straightforward since most oil and gas facilities use common types of pneumatic controllers. The most common method for determining gas savings is to reference the manufacturer specifications for the steady-state gas consumption for each device.

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<sup>1</sup> On January 23, 2014 Alberta Environment updated the GWP of methane to be 25 (from 21). For further details refer to this bulletin: <http://esrd.alberta.ca/focus/alberta-and-climate-change/regulating-greenhouse-gas-emissions/alberta-based-offset-credit-system/offset-credit-system-protocols/documents/MemoOnGlobalWarmingPotentials-Feb2014.pdf>

<sup>2</sup> The 2013 Prasino study includes field measurements of the most common pneumatic devices, while other sources such as the CAPP BMP document contain manufacturer specifications with steady-state bleed rates.



To qualify for offset credits in Alberta additional data collection is usually required and the best way to estimate potential fuel gas savings and GHG emissions is to take pre- and post-retrofit measurements of the gas vented from the controller. Often, this can be done at the same time as the retrofit is completed to avoid multiple trips to the site. To accurately account for intermittent bleed rates, it may be necessary to collect other information about the underlying process to determine how much venting can be expected from dynamic valve actuations.

#### Measurement:

To generate verifiable carbon offsets in Alberta from high to low bleed instrumentation conversion projects, it may be necessary to take vent gas measurements from a representative sample of controllers. The Alberta Offset System (AOS) Quantification Protocol for Greenhouse Gas Emissions Reductions from Pneumatic Devices specifies that at least 30 field sample measurements must be taken to generate an emission factor for a controller, if the direct measurement approach is used to quantify GHG reductions. An alternative approach in the protocol does allow for the use of manufacturer's specifications in place of measured values, provided that this approach is conservative (under-estimates GHG reductions). The AOS protocol provides detailed data collection and documentation requirements.

#### Estimating GHG Emissions:

Under the Alberta Offset System (AOS) Quantification Protocol for Greenhouse Gas Emissions Reductions from Pneumatic Devices the net GHG emission reductions are calculated based on the difference in measured or estimated vent rate between the baseline high-bleed device and the newly-installed low-bleed device, the equipment operating hours, the site gas composition (% methane), the density of methane, and the global warming potential of methane. The AOS protocol provides the full calculation.

#### A Simplified Formula to Estimate GHG Emission Reductions:

Net GHG Reductions = Baseline Emissions – Project Emissions = (Baseline High Bleed Vent Rate – Low Bleed Vent Rate, each in m<sup>3</sup>/hour)\*(Operating Hours per year)\*(% Methane in gas)\*(Density of Methane in kg/m<sup>3</sup>)\*(0.001 t/kg)\*(GWP of Methane).<sup>3</sup>

#### Estimated GHG Emission Reductions:

GHG reductions from 1,062 high to low bleed conversion projects completed by a producer in Alberta averaged 13.2scfh per device (115 mcf/controller/year), equivalent to approximately 50 tCO<sub>2</sub>e/controller/year. These retrofits included replacement of high-bleed Fisher 4150 pressure controllers with new low-bleed C1 controllers and replacement of high-bleed Fisher 546 transducers with lower-bleed Fisher I2P-100 transducers, among other retrofits. These projects reduced methane emissions by about 80-90%. Another producer's project installed 110 retrofit kits ("Mizer Kits") on Fisher 4150 pressure controllers, resulting in gas savings of 9.4 scfh per controller (82 mcf/controller/year and GHG reductions of ~36 tCO<sub>2</sub>e/controller/year. This project achieved a >85% reduction in vented emissions.

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<sup>3</sup> Global Warming Potential of Methane is 25 currently (but subject to change), per: <http://aep.alberta.ca/climate-change/guidelines-legislation/specified-gas-emitters-regulation/documents/CarbonEmissionHandbook-Mar11-2015.pdf>

Density of Methane gas at 15°C and 1atmosphere is 0.6797 kg CH<sub>4</sub>/m<sup>3</sup>, per <https://encyclopedia.airliquide.com/methane>



## Economic Analysis

**Capital Cost:** Capital costs are device- and site-specific, but costs from large retrofit programs completed in Alberta have ranged from \$1,100 to \$2,090 per controller. The equipment costs are only a fraction of the total costs as the drive time between sites and installation labour costs typically make up at least 50% of the total installed costs. Where a retrofit kit can be used (e.g. only a few components need to be swapped out from the old model to the new model, such as the relay), the capital costs may be <\$500/device for certain types of controllers.

**Operating Cost:** Operating Costs are typically the same for high-bleed and low-bleed controllers. The replacement of high-bleed devices with new low-bleed controllers may improve reliability, if the existing high-bleed equipment is old, outdated, or in poor condition. This is especially true if replacement parts are hard to find for obsolete controllers.

**Maintenance Cost:** Maintenance costs are expected to be similar for high-bleed and low-bleed controllers, but new low-bleed controllers may improve reliability compared to older, outdated, or obsolete high-bleed controllers.

**Carbon Offset Credits:** The value of carbon offsets can be very significant for high to low bleed projects and would outweigh the value of the gas savings by a significant margin using an assumed carbon offset value of \$25/offset in Alberta. The ~1,170 projects mentioned above achieved GHG reductions of between 36 to 50 tCO<sub>2</sub>e/controller/year, which could be worth \$900 to \$1,250/controller/year, assuming a carbon offset value of \$25/offset. The carbon offsets could be worth more than 4X the value of the gas savings!

**Payback, Return on Investment and Marginal Abatement Cost:** Gas Savings are the primary benefit from a high to low bleed project and will be somewhat device-specific. Gas savings from over 1,170 projects completed in Alberta averaged between 82 to 115 mcf/controller/year. At a flat \$2.50/mcf AECO gas price, these gas savings would be worth from \$200 to \$300/year.

The all-in installed capital costs for the above 1,170 retrofits ranged from \$1,100 to \$2,090 per retrofit. Without carbon offsets the payback for these types of projects is typically three to six years, although certain retrofit kits may have faster paybacks. If carbon offsets are generated, the payback can be reduced to <2 years or even under one year, but additional data collection will be required for the project to be eligible for carbon offsets.

The highly-successful retrofit program mentioned above achieved GHG reductions at the very low abatement cost of \$2.09/tCO<sub>2</sub>e.

### Barriers:



- Financial barriers – low value of fuel gas makes many projects uneconomic, although carbon offsets can improve economics. There may also be minimal capital available for energy efficiency or emission reduction projects.
- Poor quality instrument gas may lead to additional downtime if low-bleed devices have smaller nozzles that are more prone to plugging or freezing.
- Unwillingness to modify proven facility designs that are reliable.
- Remaining asset life is limited.

## Reliability

In most cases low-bleed devices can provide the same function as the previous high-bleed device, but low-bleed devices may not be appropriate for certain process control applications, such as where fast responses are required for critical infrastructure or where instrument gas quality is poor. In these cases, low-bleed devices with smaller nozzles could exacerbate problems with freeze-offs or other operational issues. It is always important to understand why the existing controller was installed in the first place and to assess the condition of the existing controller. If the baseline controller is in poor shape, then a retrofit kit should not be used and a new low-bleed controller should be swapped in instead.

## Safety

For each retrofit project, it is important to assess the process being controlled by the pneumatic controller to ensure that the new controller can safely perform the same function with the appropriate level of responsiveness. For sour gas production facilities, it is important to specify controller makes/models that contain materials that are compatible with sour service.

## Regulatory

Future Regulatory Considerations:

Both the Alberta Government<sup>4</sup> and the Federal Government<sup>5</sup> have announced their intentions to regulate methane emissions from pneumatic controllers. Draft regulations are expected in 2017 with compliance requirements by the 2020-2023 timeframe. It is expected that there will be specific limits on methane venting from pneumatic equipment, including different standards for new (greenfield) facilities as well as potential requirements to retrofit existing pneumatic equipment.

High to low bleed conversion projects are one of the most cost-effective options to significantly reduce methane emissions from pneumatic equipment to meet regulatory compliance. The highly-successful retrofit program mentioned above achieved GHG reductions at the very low abatement cost of \$2.09/tCO<sub>2</sub>e.

## Service Provider/More Information on This Practice

### References:

Alberta Government. (2017, January 25). *Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices Version 2.0*. Retrieved from Alberta Environment and Parks: <http://aep.alberta.ca/climate-change/guidelines-legislation/specified-gas-emitters-regulation/documents/PneumaticDevices-Jan25-2017.pdf>

<sup>4</sup> <https://www.alberta.ca/climate-leadership-plan.aspx#toc-5>

<sup>5</sup> <http://news.gc.ca/web/article-en.do?nid=1039219>



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