Convert Pneumatics to Mechanical Controls

Technology/Practice Overview

Description

Remote, non-electrified sites often use natural gas powered pneumatic controllers for process control. The controllers are designed to continuously bleed natural gas resulting in significant methane emissions to the atmosphere. EPA's Natural Gas STAR Partners report gas savings by replacing pneumatic controllers with mechanical devices.

The most common mechanical control device is a level controller, which uses mechanical linkages to translate the position of a liquid-level float to the position of a drain valve. No gas is used in the measurement of liquid level or in the valve actuation, and reliability is very high.

One Partner installed vertical separators equipped with mechanical dump valves at low pressure, low volume producing wells, instead of vertical separators equipped with pneumatic dump valves. Other partners have implemented this practice at oil and gas production sites and midstream dehydration facilities resulting in significant environmental and economic benefits.

A separator operating at high pressure and liquid volume requires the dump valve to be continuously throttled, allowing fluids to constantly flow out of the vessel. As lease production matures, and working pressure and fluid

Economic and Environmental Benefits

Methane Savings

Estimated annual methane emission reductions	*227 Mcf per mechanical dump separator*

Economic Evaluation

Estimated Gas Price	Annual Methane Savings	Value of Annual Gas Savings*	Estimated Implementation Cost	Incremental Operating Cost	Payback (months)
$7.00/Mcf	227 Mcf	$1,690	$3,000 *(full replacement cost)* $1,000 *(including salvage value)*[1]	$0 $0	20 Months 7 Months
$5.00/Mcf	227 Mcf	$1,200	$3,000 $1,000	$0 $0	29 Months 10 Months
$3.00/Mcf	227 Mcf	$725	$3,000 $1,000	$0 $0	47 Months 16 Months

** Whole gas savings are calculated using a conversion factor of 94% methane in pipeline quality natural gas.*
[1] In this scenario, the replaced separator is installed at a different site, and therefore, includes a salvage value.

Additional Benefits:

- Improved equipment reliability at remote sites
- Lower operating and maintenance costs

- ☐ Compressors/Engines
- ■ Dehydrators
- ☐ Directed Inspection & Maintenance
- ☐ Pipelines
- ■ Pneumatics/Controls
- ☐ Tanks
- ☐ Valves
- ■ Wells
- ☐ Other

Applicable Sector(s)

- ■ Production
- ■ Processing
- ■ Transmission
- ■ Distribution

Other Related Documents:

Convert Natural Gas-Driven Chemical Pumps, PRO No. 202

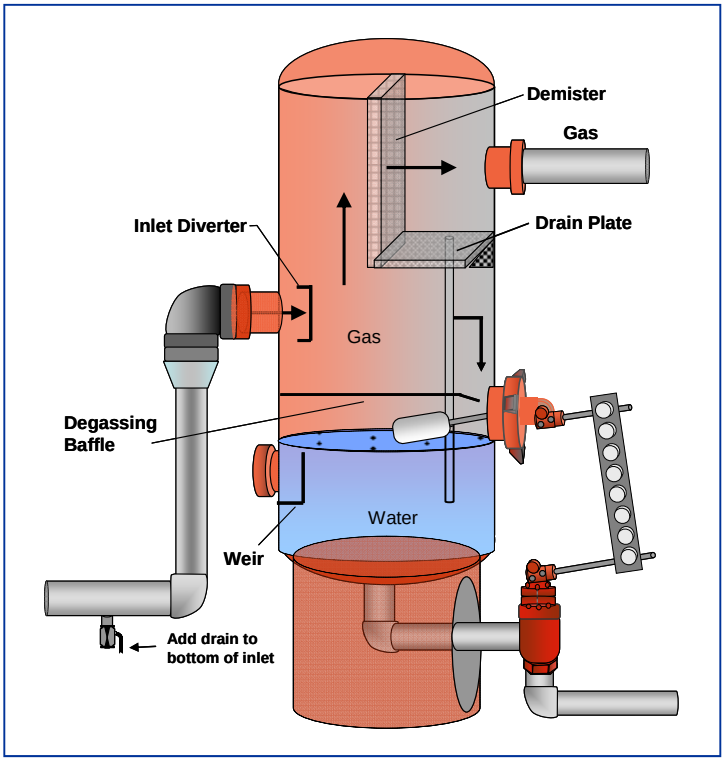
Eliminate Unnecessary Equipment and/or Systems, PRO No. 504

Convert Gas Pneumatic Controls to Instrument Air, Lessons Learned

Options for Reducing Methane Emissions From Pneumatic Devices in the Natural Gas Industry, Lessons Learned

Convert Pneumatics to Mechanical Controls (Cont'd)

Separator with Mechanical Dump



Source: S. Bumgardner, Advanced Resources International, inc.

production decline, the need for pneumatic throttle control on vessel dumps is eliminated. At this point, the lease equipment is evaluated and separators with pneumatic dump controls are frequently replaced by separators with mechanical dumps.

Mechanical Dump Separator

Source: Chesapeake Energy

Operating Requirements

Mechanical level controllers, or 'dumps', operate by a float riding on the liquid phase contained within a separator or other vessel. The float is coupled by a rod to the external linkage that moves the dump valve down to open and up to close. The only maintenance for a mechanical dump is to lubricate the linkages and clean the float arm housing. For separators, the reservoir pressure and water production of the lease must be low enough so that continuous throttling of the fluid stream is not needed.

Applicability

This technology is applicable to gas-driven pneumatic controllers where the process measurement is in close proximity to the flow control valve, flowing pressure is moderate to low, and fine throttling control of the discharge stream is not necessary.

Methane Content of Natural Gas

The average methane content of natural gas varies by natural gas industry sector. The Natural Gas STAR Program assumes the following methane content of natural gas when estimating methane savings for Partner Reported Opportunities.

Production	79 %
Processing	87 %
Transmission and Distribution	94 %

Methane Emissions

Mechanical controls eliminate both the process controller bleed and valve actuation vent emissions. A rule of thumb for estimating gas emissions from process controls is one standard cubic foot per minute (1 scf/min) of gas for each control loop, which consists of the process measurement and valve actuator. The volume of power gas used by separator dump controls and other pneumatic control devices are also available from the manufacturers of the equipment.

One Partner reports annual methane emissions of 227 Mcf from the pneumatic actuator controls of each of their separators. The average methane content of natural gas in this Partner's operations is 89 percent, so estimated annual natural gas savings are 255 Mcf per mechanical dump installation.

Convert Pneumatics to Mechanical Controls (Cont'd)

Economic Analysis

Basis for Costs and Savings

Partner-reported annual gas savings are 255 Mcf per each pneumatic-controlled separator replaced by a separator with mechanical controls. Assuming a gas price of $5.00/ Mcf, the value of the gas saved is $1,275 per separator. The replacement cost of a separator with a mechanically-controlled liquid dump valve is approximately $3,000. Often the existing pneumatic controlled separator can be refurbished and installed on a new well with higher gas pressures and water volumes. In this case, the replacement cost of the mechanical dump separator is effectively offset by moving the pneumatically controlled separator to a new high pressure, high volume well.

Another Partner reports a program that replaced the gas-liquid separators on 100 wells per year with mechanical dump separators. The reporting Partner finds it easier to replace the entire separator rather than change out only the pneumatic controls. If the pneumatic-control separator can be installed at another well site, approximately two-thirds of the replacement cost ($2,000) is applied to the new site and the remaining replacement cost ($1,000) is applied to the mechanical dump separator. Mechanical dump separators operate with less maintenance effort and operator time, and are mechanically simple devices. Incremental operating costs are virtually zero. If the typical value of gas saved is $1,275 per separator per year, project payback ranges from approximately 10 months for estimated implementation cost of $1,000 to 29 months if the full separator replacement cost of $3,000 is assumed.

Discussion

The cost of a mechanical process control system may include the process measurement equipment, the mechanical valve actuator, and piping modifications to move the control valve closer to the process vessel. Alternatively, Partners find it easier to replace the entire separator rather than just the pneumatic control.

Mechanical process control systems reduce the loss of a valuable product while requiring less maintenance effort and operator time due to mechanical simplicity.

EPA provides the suggested methane emissions estimating methods contained in this document as a tool to develop basic methane emissions estimates only. As regulatory reporting demands a higher-level of accuracy, the methane emission estimating methods and terminology contained in this document may not conform to the Greenhouse Gas Reporting Rule, 40 CFR Part 98, Subpart W methods or those in other EPA regulations.