Pneumatic Devices

Lessons Learned
from Natural Gas STAR

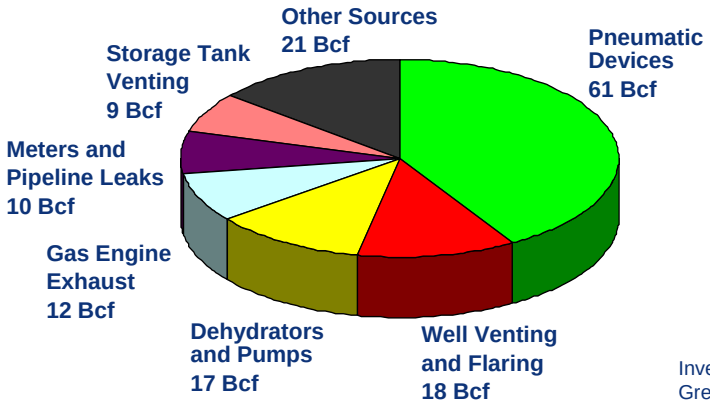
Producers and Processors
Technology Transfer Workshop

New Mexico Oil and Gas Association and
EPA's Natural Gas STAR Program
Farmington, NM
February 21, 2006

Pneumatic Devices: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions

Methane Losses: Oil and Natural Gas Production



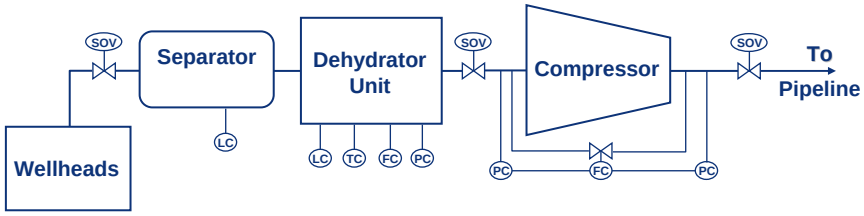
Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2003

What is the Problem?

- Pneumatic devices are major source of methane emissions from the natural gas industry
- Pneumatic devices used throughout the natural gas industry
  - Over 390,000 in production sector[1]
  - ~ 13,000 in processing sector[1]
  - Over 80,000 in transmission sector[1]

1 - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2003

Location of Pneumatic Devices at Production Sites

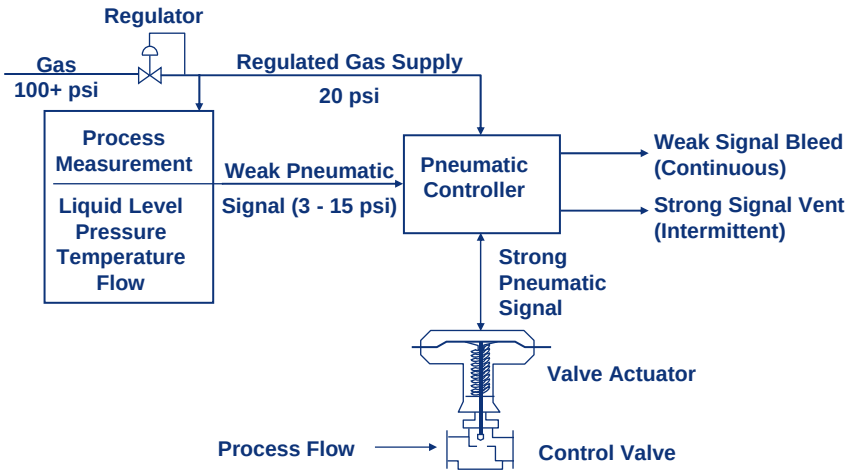


SOV = Shut-off Valve (Unit Isolation)
LC = Level Control (Separator, Contactor, Flash Tank Separator, TEG Regenerator)
TC = Temperature Control (Regenerator Fuel Gas)
FC = Flow Control (TEG Circulation, Compressor Bypass)
PC = Pressure Control (FTS Pressure, Compressor Suction/Discharge)

Methane Emissions

- As part of normal operations, pneumatic devices release natural gas to atmosphere
- High-bleed devices bleed in excess of 6 cf/hr
  - Equates to >50 Mcf/yr
  - Typical high-bleed pneumatic devices bleed an average of 140 Mcf/yr
- Actual bleed rate is largely dependent on device's design

Pneumatic Device Schematic



Emissions from Pneumatic Devices

	Gas Industry[1]	Oil Industry[1]
Production	**42.4 Bcf**	**18.6 Bcf**
Processing	**0.1 Bcf**	**---**
Transmission	**11.4 Bcf**	**---**
Total	**53.9 Bcf**	**18.6 Bcf**
Total Gas/Oil		**72.5 Bcf/yr**

1 - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2003

How Can Methane Emissions be Recovered?

- Option 1: Replace high-bleed devices with low-bleed devices
- Option 2: Retrofit controller with bleed reduction kits
  - Field experience shows that up to 80% of all high-bleed devices can be replaced or retrofitted with low-bleed equipment
- Option 3: Maintenance aimed at reducing losses

Option 1: Replace High-Bleed Devices

- Most applicable to:
  - Controllers: liquid-level and pressure
  - Positioners and transducers
- Suggested action: evaluate replacements
  - Replace at end of device's economic life
  - Early replacement

Norriseal
Pneumatic Liquid
Level Controller

Source: www.norriseal.com

Fisher
Electro-Pneumatic
Transducer

Source: www.emersonprocess.com

Option 1: Cost to Replace High-Bleed Devices

- Costs vary with size
  - Typical costs range from $700 to $3,000 per device
  - Incremental costs of low-bleed devices are modest ($150 to $250)
  - Gas savings often pay for replacement costs in short periods of time (2 to 8 months)

Option 2: Retrofit with Bleed Reduction Kits

- Applicable to most high-bleed controllers
- Suggested action: evaluate cost effectiveness as alternative to early replacement
- Retrofit kit costs ~ $500
- Payback time ~ 9 months

Option 3: Maintenance to Reduce Losses

- Applies to all pneumatic devices
- Suggested action: add to routine maintenance procedures
  - Field survey of controllers
  - Where process allows, tune controllers to minimize bleed

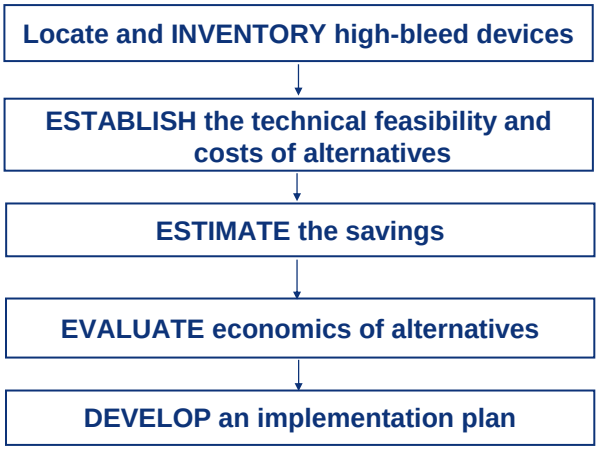
Option 3: Maintenance to Reduce Losses (cont'd)

- Suggested action (cont'd)
  - Re-evaluate the need for pneumatic positioners
  - Repair/replace airset regulators
  - Reduce regulated gas supply pressure to minimum
  - Routine maintenance should include repairing/replacing leaking components
- Costs are low

Becker
Single-Acting
Valve Positioner

Source: www.bpe950.com

Five Steps for Reducing Methane Emissions from Pneumatic Devices



Suggested Analysis for Replacement

- Replacing high-bleed controllers at end of their economic life
  - End of economic life when major overhaul required
  - Determine incremental cost of low-bleed device over high-bleed equivalent
  - Determine gas saved with low-bleed device using manufacturer specifications
  - Compare savings and cost
- Early replacement of high-bleed controllers
  - Compare gas savings of low-bleed device with full cost of replacement

Economics of Replacement

Implementation[1]	Replace at End of Life	Early Replacements	
		Level Control	Pressure Control
Cost ($)	150 – 250[2]	380	1,340
Annual Gas Savings (Mcf)	50 – 200	166	228
Annual Value of Saved Gas ($)[3]	500 – 2000	1660	2280
IRR (%)	333 – 800	437	169
Payback (months)	2 – 4	3	7

1 - All data based on Partners' experiences. See *Lessons Learned* for more information.
2 - Range of incremental costs of low-bleed over high bleed equipment
3 - Gas price is assumed to be $10/Mcf.

Suggested Analysis for Retrofit

- Retrofit of low-bleed kit
  - Compare savings of low-bleed device with cost of conversion kit
  - Retrofitting reduces emissions by average of 90%

Economics of Retrofit

	Retrofit[1]
Implementation Costs[2]	$500
Bleed rate reduction (Mcf/device/yr)	219
Value of gas saved ($/yr) [3]	2190
Payback (months)	3
IRR	438%

1 - On high-bleed controllers
2 - All data based on Partners' experiences. See *Lessons Learned* for more information.
3 - Gas price is assumed to be $10/Mcf.

Suggested Analysis for Maintenance

- For maintenance aimed at reducing gas losses
  - Measure gas loss before and after procedure
  - Compare savings with labor (and parts) required for activity

Economics of Maintenance

	Reduce Supply Pressure	Repair & Retune	Change Settings	Remove Valve Positioners
Implementation Cost ($)[1]	153	23	0	0
Gas Savings (Mcf/yr)	175	44	88	158
Value of gas saved ($/yr)[2]	1750	440	880	1580
Payback (months)	1.0	<1	<1	<1
IRR	1144%	---	---	---

1 - All data based on Partners' experiences. See *Lessons Learned* for more information.
2 - Gas price is assumed to be $10/Mcf.

Pneumatic Devices

- Factors affecting economics of replacement
  - Operating cost differential and capital costs
  - Estimated leak rate reduction per new device
  - Price of gas ($/Mcf)

Lessons Learned

- Most high-bleed pneumatics can be replaced with lower bleed models
- Replacement options save the most gas and are often economic
- Retrofit kits are available and can be highly cost-effective
- Maintenance is low-cost and reduces gas loss

Case Study – Marathon

- Surveyed 158 pneumatic devices at 50 production sites
- Half of the controllers were low-bleed
- High-bleed devices included
  - 35 of 67 level controllers
  - 5 of 76 pressure controllers
  - 1 of 15 temperature controllers

Marathon Study: Hear It? Feel It? Replace It!

- Measured gas losses total 5.1 MMcf/yr
- Level controllers account for 86% of losses
  - Losses averaged 7.6 cf/hr/device
  - Losses ranged up to 48 cf/hr/device (420 Mcf/yr)
- Concluded that excessive losses can be heard or felt

Recommendations

- Evaluate all pneumatics to identify candidates for replacement and retrofit
- Choose lower bleed models at change-out where feasible
- Identify candidates for early replacement and retrofits by doing economic analysis
- Improve maintenance
- Develop an implementation plan

Discussion Questions

- To what extent are you implementing these opportunities?
- How could these opportunities be improved upon or altered for use in your operation?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing these practices?