Options for Reducing Methane Emissions from Pneumatic Devices

Lessons Learned from the
Natural Gas STAR Program

Producers Technology Transfer Workshop

Newfield Exploration Company,
Anadarko Petroleum Corporation,
Utah Petroleum Association,
Interstate Oil & Gas Compact Commission,
Independent Petroleum Association of Mountain States

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epa.gov/gasstar

Pneumatic Devices: Agenda

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

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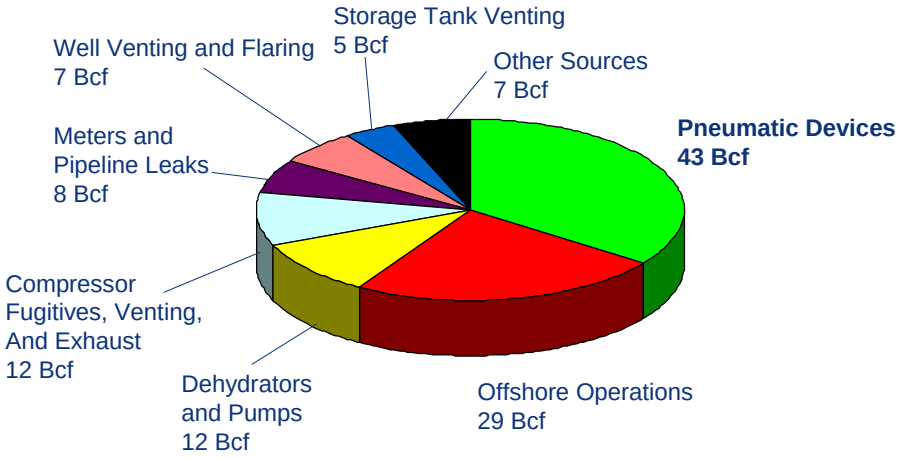
2007 Production Sector Methane Emissions



EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2007.* April, 2009. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html
Note: Natural Gas STAR reductions from gathering and boosting operations are reflected in the production sector.

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What is the Problem?

- Pneumatic devices are collectively a major source of methane emissions from the natural gas industry
- Natural gas powered pneumatic devices used throughout the oil and natural gas industry

	Natural Gas Systems	Petroleum Systems
Production and Gathering[1]	411,000	379,436
Processing[1]	11,000	-
Transmission and Storage[1]	85,000	-

1 - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2008

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Methane Emissions

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

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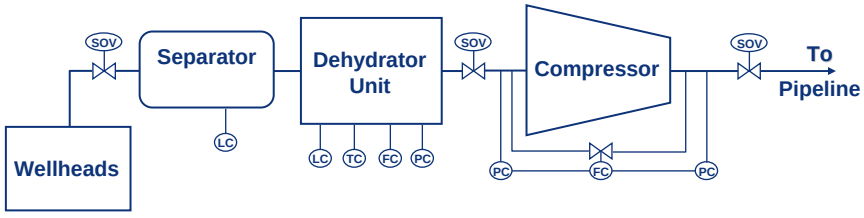
Location of Pneumatic Devices at Production Sites



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)

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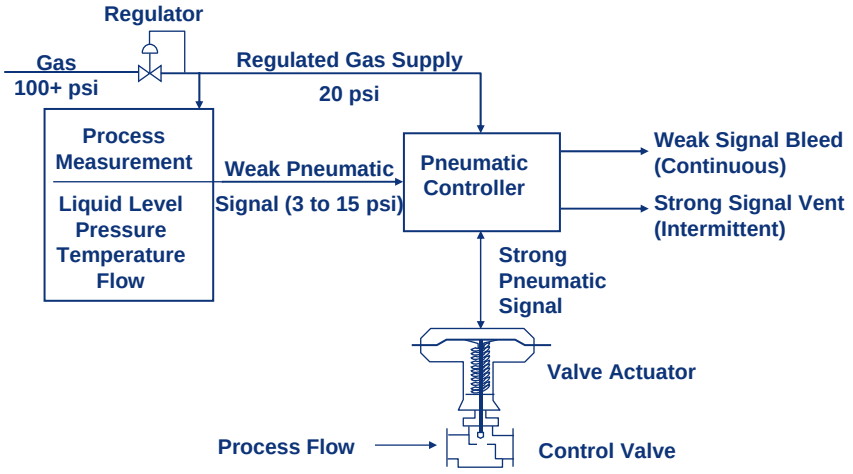
Pneumatic Device Schematic



psi = pounds per square inch

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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

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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

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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)

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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 ~ $675
- Payback time ~ 9 months

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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

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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

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Five Steps for Reducing Methane Emissions from Pneumatic Devices

Locate and INVENTORY high-bleed devices

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ESTABLISH the technical feasibility and costs of alternatives

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ESTIMATE the savings

↓

EVALUATE economics of alternatives

↓

DEVELOP an implementation plan

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Suggested Analysis for Replacement

- Replacing high-bleed controllers at end of their economic life
  - End of economic life when major overhaul cost avoided
  - 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

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Economics of Replacement

	Replace at End of Life	Early Replacement	
		Level Control	Pressure Control
Cost ($) [1]	210 – 340 [2]	513	1809
Annual Gas Saving (Mcf)	50 - 200	166	228
Annual Value of Gas Saved ($) [3]	350 - 1400	1165	1596
Paybacks (months)	3 - 8	6	14
IRR (%) [4]	138 - 933	226	84

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 $7/Mcf
4 - Internal Rate of return IRR calculated over 5 years

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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%

	Level Controllers			Pressure Controllers
	Mizer	Large to small orifice	Large to small nozzle	Large to small orifice
Implementation Costs[1] ($)	675	41	189	41
Bleed rate reduction (Mcf/device/year)	219	184	131	184
Value of gas saved ($/year) [2]	1533	1288	917	1288
Payback (months)	6	<1	3	<1
IRR (%) [3]	226	>3100	>450	>3100

1 - All data based on partners' experiences. See *Lessons Learned* for more information
2 - Gas price is assumed to be $7/Mcf
3 - Internal Rate of return IRR calculated over 5 years

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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

	Reduce Supply Pressure	Repair & Retune	Change Settings	Remove Valve Positioners
Implementation Cost ($) [1]	207	31	0	0
Gas Savings (Mcf/year)	175	44	88	158
Value of gas saved ($/year) [2]	1225	308	616	1106
Payback (months)	3	2	immediate	Immediate
IRR [3]	>500%	>900	---	---

1 - All data based on partners' experiences. See *Lessons Learned* for more information
2 - Gas price is assumed to be $7/Mcf
3 – Internal rate of return (IRR) calculated over 5 years

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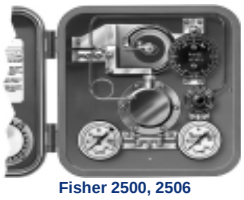
Industry Experience – Chesapeake Energy

- Level controllers retrofitted with Mizer components
- Hi-flow sampler used to measure emissions reduction from retrofits



Fisher 2500, 2506
Retrofit w/ Mizer, bracket, tubing & relay plug

Cemco/WellMark 6900
Retrofit w/ Mizer Valve

Invalco 415, 215, 402
Retrofit w/ Mizer valve, block & gauges

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Industry Experience – Chesapeake Energy

District	Retrofits Done Thru 31-Mar-09	Total Capital ($)	Daily Reduction (MCF)	Annual Reduction (MMCF)
Anadarko	1264	685,088	885	324
Arkansas	100	54,200	70	26
N. Mid Continent	467	253,114	327	98
Southern Oklahoma	372	201,264	260	99
W. Mid Continent	47	25,474	33	13
Gulf Coast	161	87,262	113	41
Louisiana	17	9,214	12	4
N. Permian	93	20,406	65	24
S. Permian	149	80,578	104	22
Total	2,670	1,447,140	1869	651

Average Installation Cost = $542

Using $3.50/MCF, the simple payback is 7 months

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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

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Discussion Questions

- To what extent are these opportunities being implemented?
- 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?

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