Pneumatic Devices

Lessons Learned from Natural Gas STAR

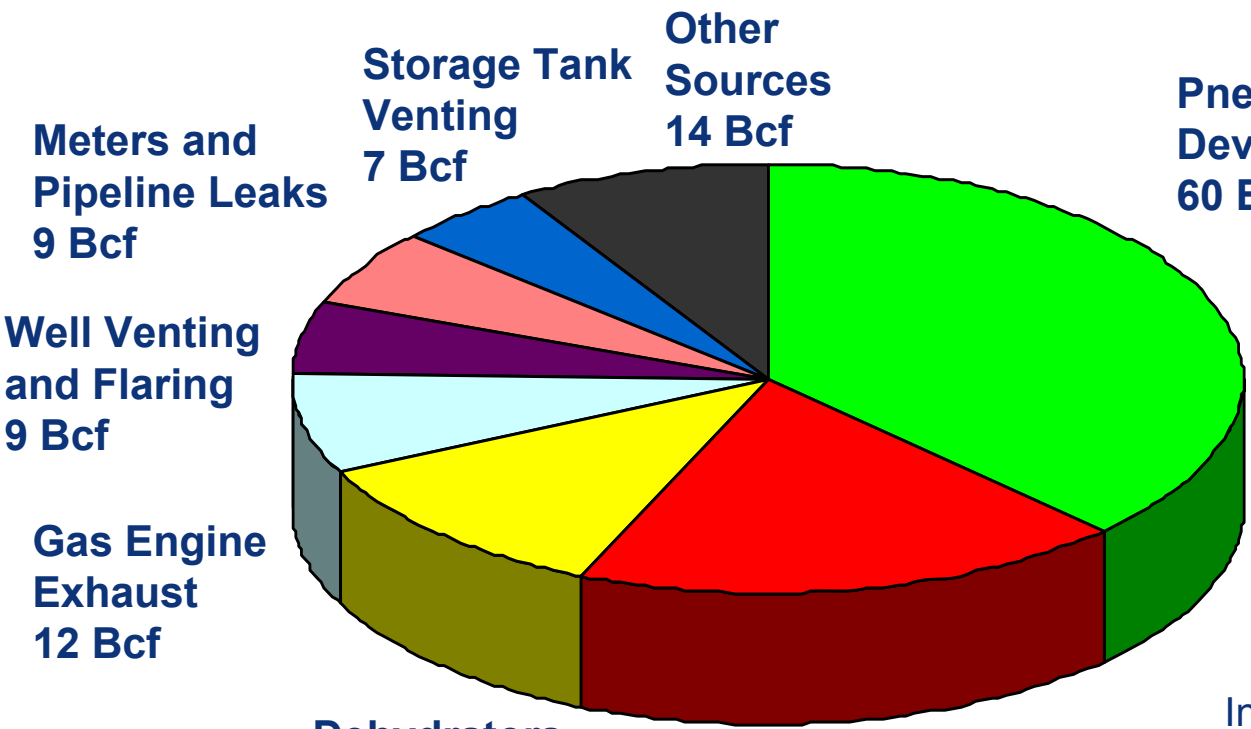
Producers Technology Transfer Workshop

Occidental Oil and Gas and
EPA's Natural Gas STAR Program
Midland, TX
June 8, 2006

Pneumatic Devices: Agenda

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

Methane Losses: Oil and Natural Gas Production



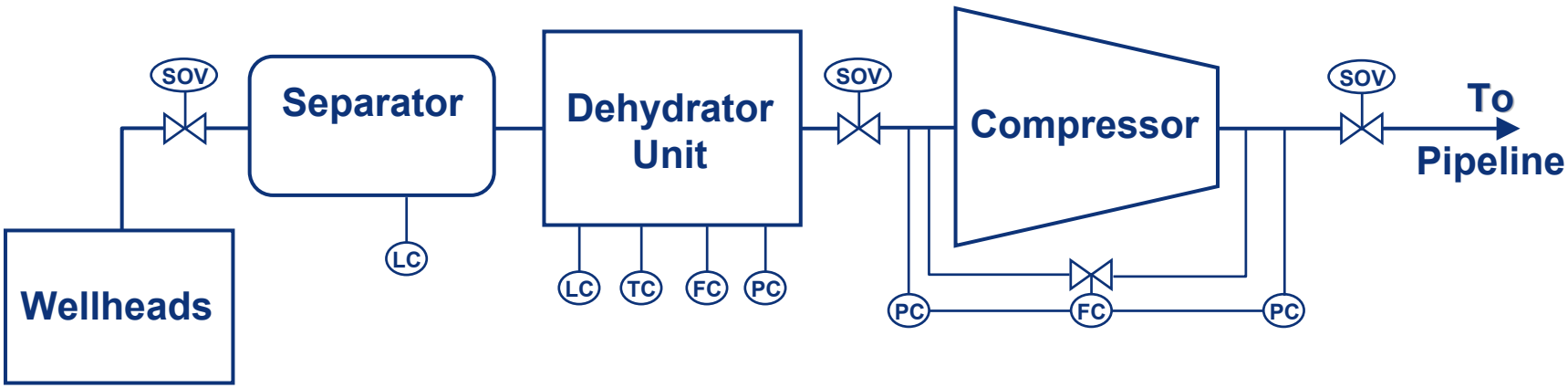
Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2004

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 400,000 in production sector[1]
  - About 13,000 in processing sector[1]
  - Over 85,000 in transmission sector[1]

1 - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2004

Location of Pneumatic Devices at Production Sites

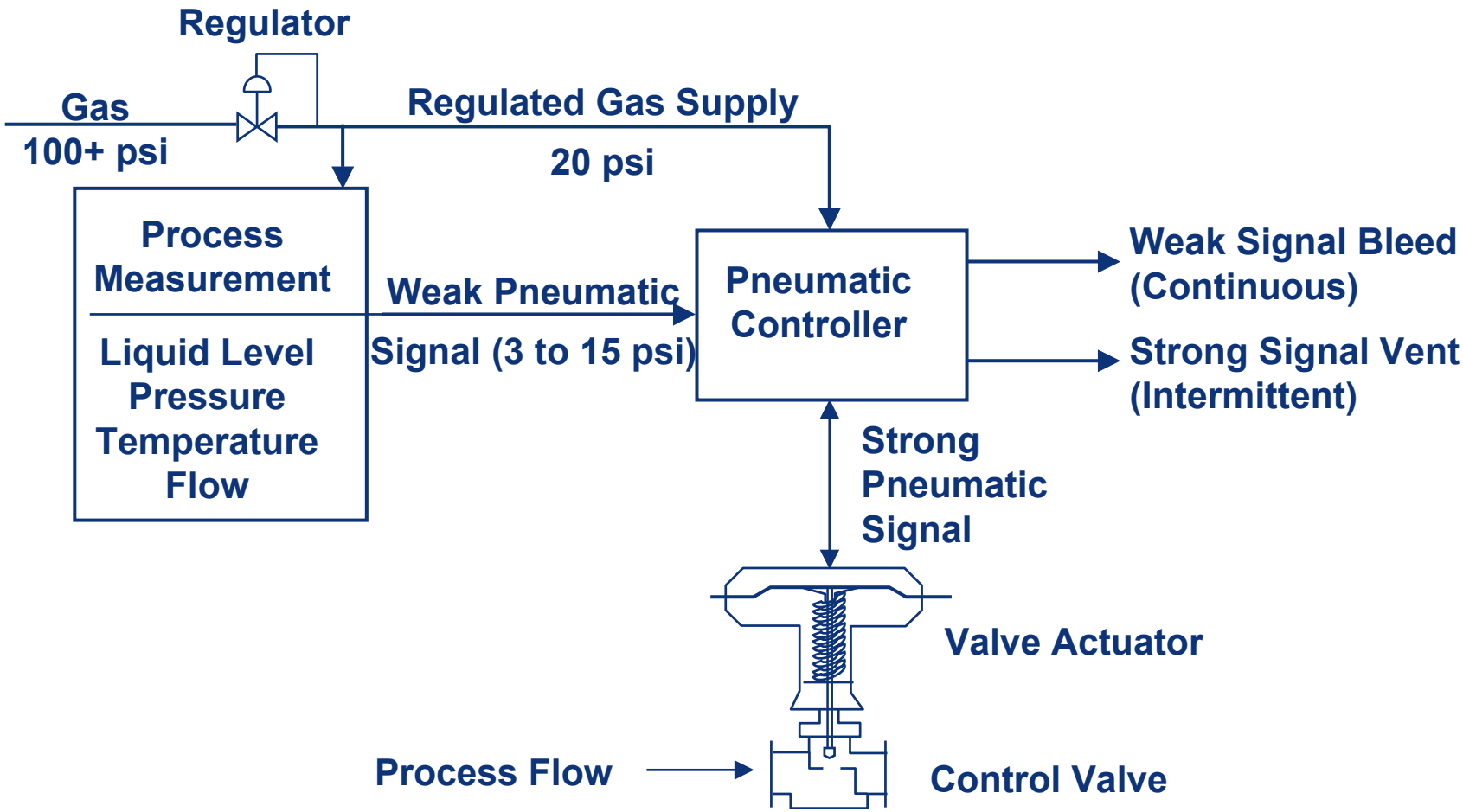


SOV = Shut-off Valve (Unit Isolation)
LC = Level Control (Separator, Contactor, Flash Tank Separator, TEG Regenerator)
TC = Temperature Control (Regenerator Fuel Gas)
FC = Flow Control (TEG Circulation, Compressor Bypass)
PC = Pressure Control (FTS Pressure, Compressor Suction/Discharge)

Methane Emissions

- As part of normal operations, pneumatic devices release natural gas to atmosphere
- High-bleed devices bleed in excess of 6 cf/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

Pneumatic Device Schematic



psi = pounds per square inch

Emissions from Pneumatic Devices

	Gas Industry[1]	Oil Industry[1]
Production	**41.8 Bcf**	**17.8 Bcf**
Processing	**0.1 Bcf**	**---**
Transmission	**10.7 Bcf**	**---**
Total	**52.6 Bcf**	**17.8 Bcf**
Total Gas/Oil		**70.4 Bcf/yr**

1 - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2004

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

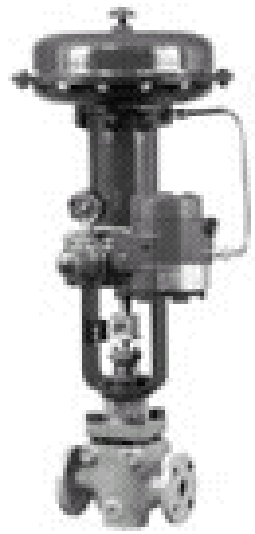
Option 1: Replace High-Bleed Devices

- 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

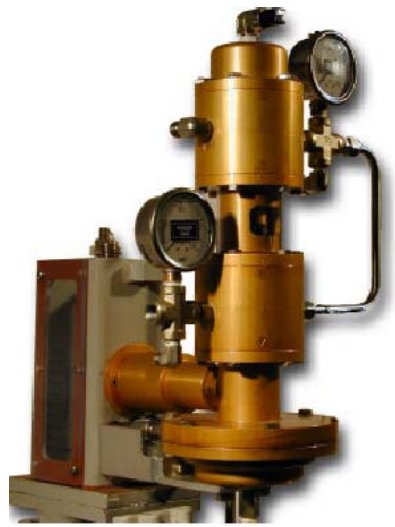
Option 3: Maintenance to Reduce Losses

- 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)

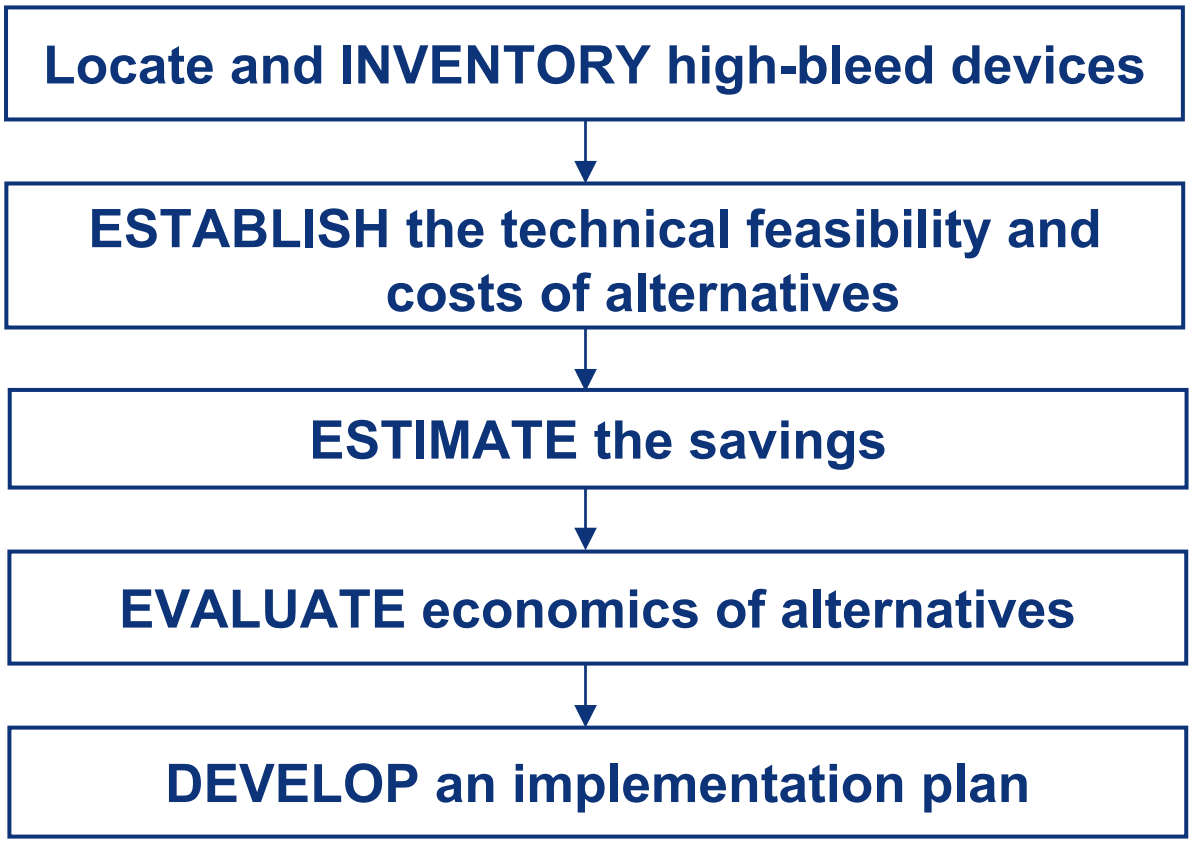
- Suggested action (cont'd)
  - Re-evaluate the need for pneumatic positioners
  - Repair/replace airset regulators
  - Reduce regulated gas supply pressure to minimum
  - Routine maintenance should include repairing/replacing leaking components
- Costs are low

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]	350 – 1400	1162	1596
IRR (%)	138 – 933	306	117
Payback (months)	2 – 9	4	10

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

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]	$500
Bleed rate reduction (Mcf/device/year)	219
Value of gas saved ($/year)[3]	1533
Payback (months)	4
IRR	306%

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 $7/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]	1225	308	616	1106
Payback (months)	1.5	<1	<1	<1
IRR	801%	---	---	---

1 - All data based on partners' experiences. See *Lessons Learned* for more information.
2 - Gas price is assumed to be $7/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/year
- Level controllers account for 86% of losses
  - Losses averaged 7.6 cf/hour/device
  - Losses ranged up to 48 cf/hour/device (420 Mcf/year)
- 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?