Best Operating Practices for Reducing Emissions

From Natural Gas STAR Partners

Murphy Exploration & Production,

Gulf Coast Environmental Affairs Group,

American Petroleum Institute, and

EPA's Natural Gas STAR Program

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Why Are Best Operating Practices Important?

- Many production facilities have identified practical cost effective methane emissions practices
- Production partners report saving 129 Bcf since 1990, 83% from PRO's
- VRU's account for 30% of PRO emissions reductions

Why Are Best Operating Practices Important?

- Simple vehicle for sharing successes and continuing program's future
  - *BMP's:* the consensus best practices
  - *PRO's:* Partner Reported Opportunities
  - *Lessons Learned:* expansion on the most advantageous BMP's and PRO's
  - All posted on the Gas STAR website: *http://www.epa.gov/gasstar*

Production Best Management Practices

- BMP 1: Install and Replace High-Bleed Pneumatics
- BMP 2: Install Flash Tank Separators on Glycol Dehydrators
- BMP 3: Partner Reported Opportunities (PRO's)

Gas STAR PRO Fact Sheets

- PRO Fact Sheets from Annual Reports 1994-2002
  - 54 posted PRO's
  - 36 PRO's applicable to Production
    - 12 focused on operating practices
    - 24 focused on technology
  - Several new PRO sheets under development

Lessons Learned

- 14 Lessons Learned on website
- 7 applicable to production
  - 2 focused on operating practices
  - 5 focused on technology
- New Lessons Learned under development
  - Composite Wrap
  - Desiccant Dehydration

Best Operating Practice Lessons Learned

- Replacing Gas-Assisted Glycol Pumps with Electric Pumps
- Reducing the Glycol Circulation Rates in Dehydrators

Production Best Operating Practices

- Compressors & Engines
  - Convert Engine Starting to Air
    - SAVES…1,356 Mcf/yr
    - PAYOUT…< 1 year
  - Convert Engine Starting to Nitrogen
    - SAVES… 1,350 Mcf/yr
    - PAYOUT…< 1yr

What is the Problem?

Compressor starts vent methane

- How much methane is emitted?
  - Up to 135 Mcf per start
- How can these losses be reduced?
  - Alternative operating practices
    - Use nitrogen
    - Use air
  - Alternative technology
    - Use electric starters
    - Convert to electric drive

Partner Experience

Compressor starts vent methane

- Partners report 1,350 Mcf/yr savings per compressor using air or nitrogen assuming ten starts per year
  - Availability and cost of air and nitrogen are issues
  - Capital costs for electric starters reduce payout
  - Coordinating starts and shutdowns with maintenance schedules are an option
  - Modification of purge procedures to recover gas prior to venting can also gain savings with low costs

More Operating Practices

Other

- Eliminate Unnecessary Equipment or Systems
  - SAVES… 2,000 Mcf/yr
  - PAYOUT… < 1yr
- Begin Directed Inspection and Maintenance at Remote Facilities
  - SAVES… 362 Mcf/yr
  - PAYOUT… 1-3 yrs
- Lower Heater-Treater Temperatures
  - SAVES… 142 Mcf/yr
  - PAYOUT… < 1yr

What is the Problem?

Unnecessary equipment or systems provide sources of methane emissions

- How much methane is emitted**?**
  - One unnecessary process controller vents 1 cfm or 0.5 MMcf/yr
- Other benefits
  - Increases efficiency
  - Lowers operating & maintenance costs

Partner Experience

Unnecessary equipment or systems provide sources of methane emissions

- One partner reports savings of 7,940 Mcf/yr by eliminating 31 dehydrators with an average of 4 controller loops each
  - Payback was < 1 year

More Operating Practices

Tanks

- Consolidate Crude Oil Production & Water Tank Storage
  - SAVES… 4,200 Mcf/yr
  - PAYOUT… < 1 yr
- Convert Water Tank Blanket to Produced $C0_2$
  - SAVES… 2,000 Mcf/yr
  - PAYOUT… 1-3 years

What is the Problem?

Tankage is a large source of methane emissions

- How much methane is emitted?
  - EPA Guideline 42 or API "E&P TANK" Program provide specific guidance. Partners report up to 1,000 Mcf/yr
- How can these losses be reduced?
  - Tankage consolidation reduces maintenance costs and promotes justification of vapor recovery or alternative blanketing with produced CO_2

Partner Experience

Tankage is a large source of methane emissions

- One partner reports 32,600 Mcf/yr by converting water tank blankets on 9 units at a water treatment station from fuel gas to CO2 -rich produced gas. Payback was 1-3 years
- Capital costs are a major factor but gas savings are usually substantial

More Operating Practices

Valves

- Inspect & Repair Compressor Station Blowdown Valves
  - SAVES…2,000 Mcf/yr
  - PAYOUT… < 1 yr
- Test & Repair RV's
  - SAVES…170 Mcf/yr
  - PAYOUT… < 1 yr
- Test & Repair Gate Station RV's with Nitrogen
  - SAVES… 8 Mcf/yr
  - PAYOUT… >10 yrs

What is the Problem?

Leaking valves are another large source

- How much methane is emitted?
  - As RV components wear or foul leakage occurs
  - Estimate 200 Mcf/yr per leaker
- How can these losses be reduced?
  - Leak check & repair on a planned schedule

Partner Experience

Leaking valves are another large source

- One partner reports saving 3,907 Mcf/yr by repairing 7 RV's. Payback was immediate
- Another partner reports saving 853 Mcf/yr by repairing compressor RV's
- Another Partner reports saving 10 Mcf/yr by using nitrogen to test 120 RV's versus "popping" off with natural gas

One of the Newer Operating Practices

- Begin Directed Inspection and Maintenance at Remote Facilities
  - SAVES… 362 Mcf/yr
  - PAYOUT … 1-3 yrs

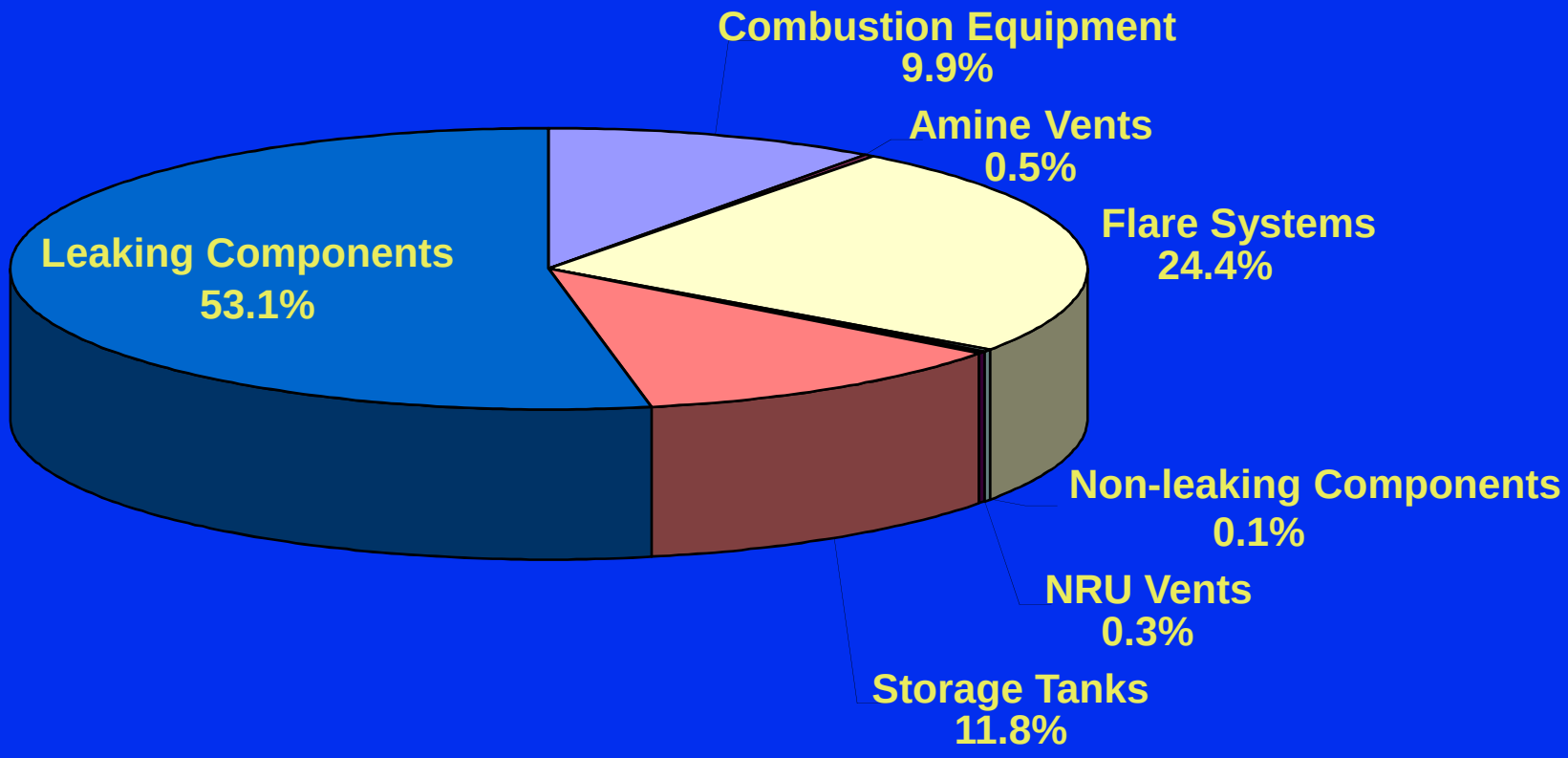
Bubble test on leaking valve

Source: CLEARSTONE ENGINEERING LTD

What is the Problem?

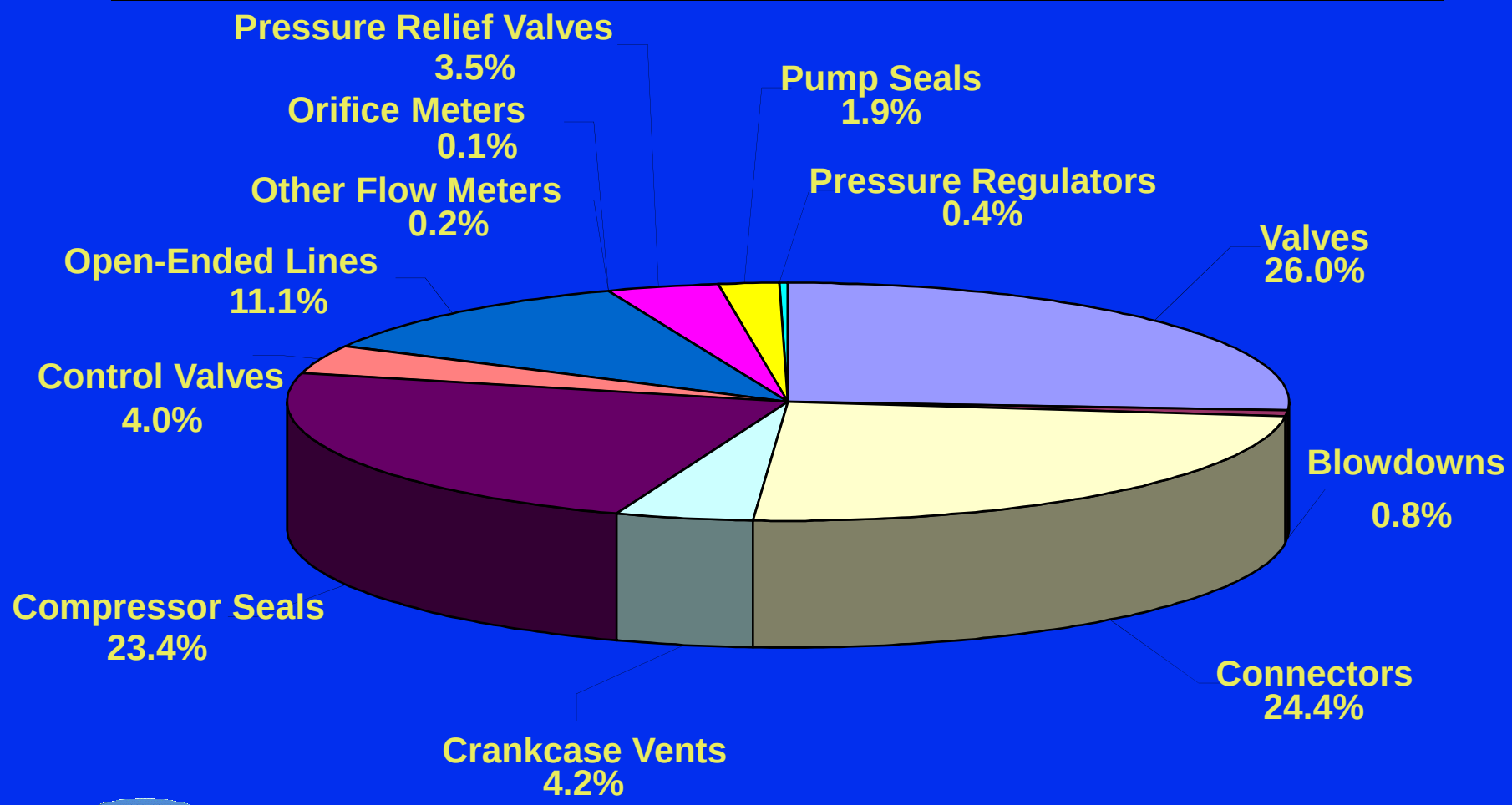
- Gas leaks are invisible, unregulated and go unnoticed
- STAR partners find that valves, connectors, compressor seals and open-ended lines (OEL) are major sources
  - 27 Bcf of methane are emitted per year by reciprocating compressors seals and OELs
  - Open ended lines contribute half these emissions
- Facility fugitive methane emissions depend on operating practices, equipment age and maintenance

Natural Gas Losses by Source



Source: Clearstone Engineering, 2002

Natural Gas Losses by Equipment Type



Source: Clearstone Engineering, 2002

How Much Methane is Emitted?

Methane Emissions from Leaking Components at Gas Processing Plants			
Component Type	**% of Total Methane Emissions**	**% Leaks**	**Estimated Average Methane Emissions per Leaking Component (Mcf/Year)**
Valves (Block & Control)	26.0 %	7.4 %	66
Connectors	24.4 %	1.2 %	80
Compressor Seals	23.4 %	81.1 %	372
Open-ended Lines	11.1 %	10.0 %	186
Pressure Relief Valves	3.5 %	2.9 %	844

Source: Clearstone Engineering, 2002, Identification and Evaluation of Opportunities to Reduce Methane Losses at Four Gas Processing Plants. Report of results from field study of 4 gas processing plants in WY and TX to evaluate opportunities to economically reduce methane emissions.

How Much Methane is Emitted?

Summary of Natural Gas Losses from the Top Ten Leakers[1].				
Plant No.	Gas Losses From Top 10 Leakers (Mcfd)	Gas Losses From All Equipment Leakers (Mcfd)	Contribution By Top 10 Leakers (%)	Contribution By Total Leakers (%)
1	43.8	122.5	35.7	1.78
2	133.4	206.5	64.6	2.32
3	224.1	352.5	63.6	1.66
4	76.5	211.3	36.2	1.75
Combined	477.8	892.84	53.5	1.85

[1]Excluding leakage into flare system

How Can These Losses Be Reduced?

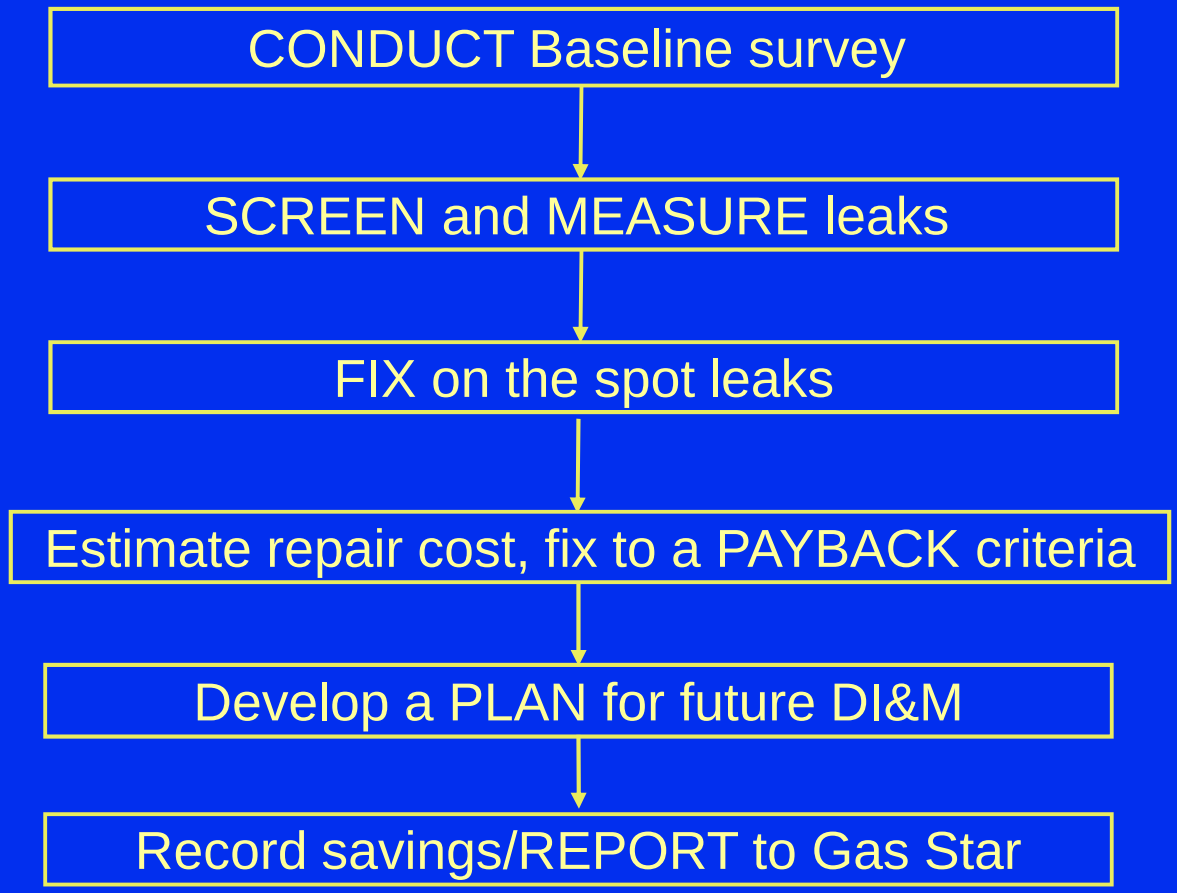
- Implementing a Directed Inspection and Maintenance (DI&M) Program

Source: CLEARSTONE ENGINEERING LTD

What is a DI&M Program?

- Implementing a Directed Inspection and Maintenance Program
  - Voluntary program to identify and fix leaks that are cost effective to repair
  - Outside of mandatory LDAR
  - Survey cost will pay out in the first year
  - Provides valuable data on leakers

How Do You Implement A DI&M Program?



Screening and Measurement

Summary of Screening and Measurement Techniques		
Instrument/ Technique	**Effectiveness**	**Approximate Capital Cost**
Soap Solution	★ ★	$
Electronic Gas Detectors	★	$$
Acoustic Detection/ Ultrasound Detection	★ ★	$$$
TVA (FID)	★	$$$
Bagging	★	$$$
High Volume Sampler	★ ★ ★	$$$
Rotameter	★ ★	$$
Source: EPA's Lessons Learned Study		

Cost-Effective Repairs

Repair the Cost Effective Components			
Component	**Value of Lost gas[1] ($)**	**Estimated Repair cost ($)**	**Payback (Months)**
Plug Valve: Valve Body	12,641	200	0.2
Union: Fuel Gas Line	12,155	100	0.1
Threaded Connection	10,446	10	0.0
Distance Piece: Rod Packing	7,649	2,000	3.1
Open-Ended Line	6.959	60	0.1
Compressor Seals	5,783	2,000	4.2
Gate Valve	4,729	60	0.2
Source: Hydrocarbon Processing, May 2002 [1]Based on $3/Mcf gas price			

DI&M - Partner Experience

- **Partner A**: A leaking cylinder head was tightened, which reduced the methane emissions from almost 64,000 Mcf/yr per year to 3,300 Mcf/yr
  - The repair required 9 man-hours of labor and the annualized gas savings were approximately 60.7 MMcf/yr At $3.00/Mcf, the estimated value of the gas saved was $182,100/year
- **Partner B**: A one-inch pressure relief valve emitted almost 36,774 Mcf/yr
  - Five man-hours of labor and $125 of materials eliminated the leak. The annualized value of the gas saved was more than $110,300 at $3.00/Mcf

DI&M - Partner Experience

- **Partner C**: A blowdown valve leaked almost 14,500 Mcf/yr
  - Rather than replace the expensive valve, the Partner spent just $720 on labor and materials to reduce the emissions to approximately 100 Mcf/yr
  - The gas saved was approximately 14,400 Mcf/year, worth $43,200 at $3.00/Mcf
- **Partner D**: A tube fitting leaked at a rate of 4,121 Mcf/yr
  - A very quick repair requiring only five minutes reduced the leak rate to 10 Mcf/yr
  - At $3.00/Mcf, the annualized value of the gas saved was approximately $12,300

Discussion Questions

- To what extent are you implementing these opportunities?
- Can you suggest other 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, etc.) that are preventing you from implementing these practices?