Directed Inspection and Maintenance at Gas Processing Plants

Lessons Learned from the Natural Gas STAR Program

DCP Midstream and the Gas Processors Association

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epa.gov/gasstar

Directed Inspection and Maintenance at Gas Processing Plants Outline

- Methane Losses
  - What are the Sources of Emissions?
  - How Much Methane is Emitted?
- Methane Recovery
  - Directed Inspection and Maintenance (DI&M)
  - DI&M by Infrared Leak Detection
- Is Recovery Profitable?
- Partner Experience
- Discussion

Methane Losses

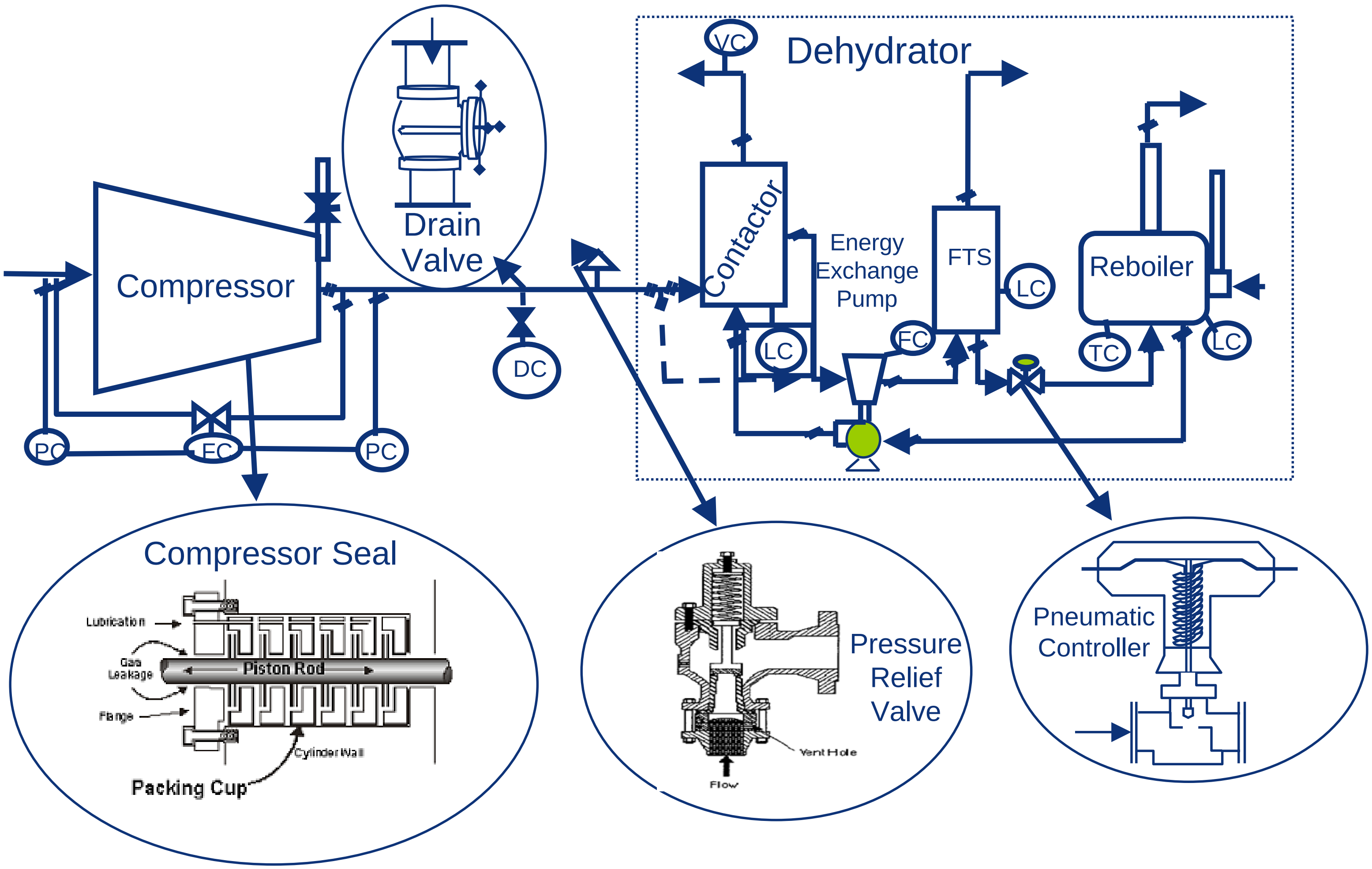
- Estimated 561 processing plants nationally
- Estimated 4,900 compressors in processing sector
- National fugitive and compressor seal methane emissions from processing plants is estimated to be 23 billion cubic feet per year (Bcf/year)
- Estimated 41 million cubic feet (MMcf) per plant-year methane emissions
  - Worth $287,000/plant-year

Source: Chevron/Unocal

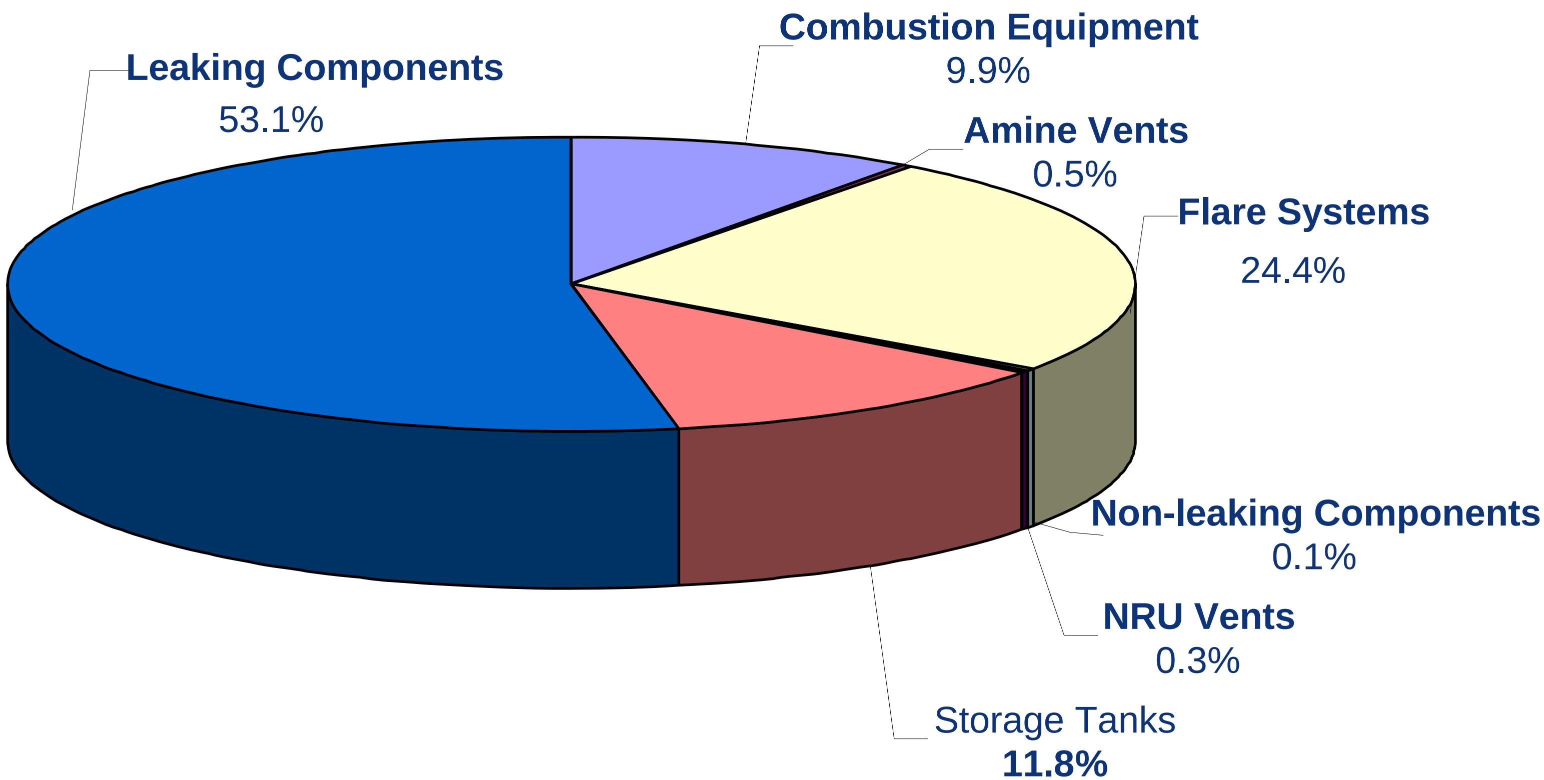
What is the Problem?

- Gas leaks are invisible, unregulated, and go unnoticed
- Natural Gas STAR Partners find that valves, connectors, compressor seals, and open-ended lines (OELs) are major methane emission sources
  - In 2005, 23 Bcf of methane was emitted by reciprocating compressor seals and OELs, each contributing equally to the emissions
  - Gas plant fugitive methane emissions depend on operating practices, equipment age, and maintenance

What are the Sources of Emissions?

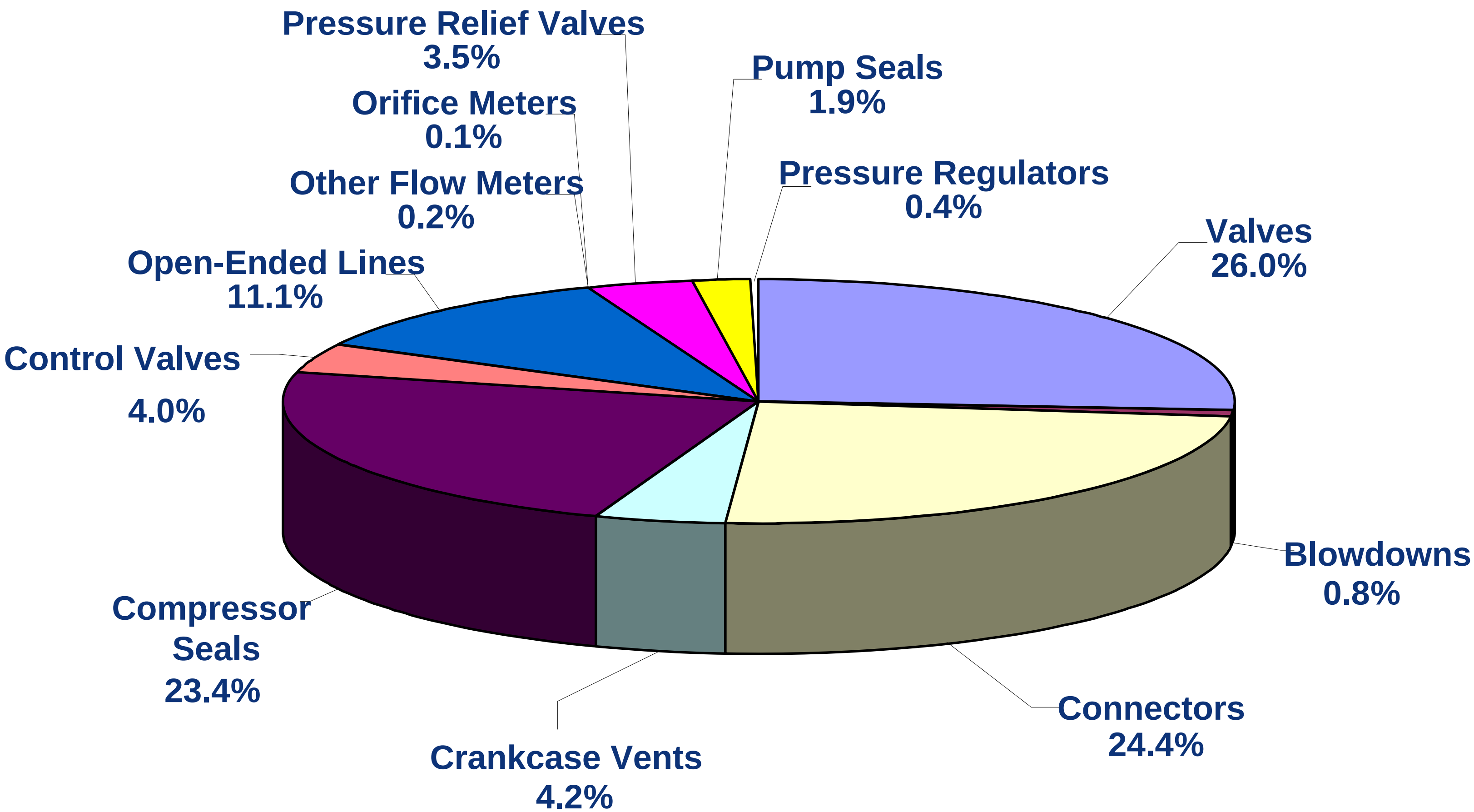


Distribution of Losses by Source Category



Source: Clearstone Engineering, 2002

Distribution of Losses from Equipment Leaks by Type of Component



Source: Clearstone Engineering, 2002

How Much Methane is Emitted?

Methane Emissions from Leaking Components at Gas Processing Plants			
Component Type	**% of Total Methane Emissions**	**% Leak Sources**	**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 four gas processing plants in Wyoming and Texas to evaluate opportunities to economically reduce methane emissions.			

Mcf = Million cubic feet

How Much Methane is Emitted?

Summary of Natural Gas Losses from the Top Ten Leak Sources[1]				
Plant Number	**Gas Losses From Top 10 Leak Sources (Mcf/day)**	**Gas Losses From All Leak Sources (Mcf/day)**	**Contribution By Top 10 Leak Sources (%)**	**Contribution By Total Leak Sources (%)**
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	892.8	53.5	1.85
1 – Excluding leakage into flare system				

Methane Recovery

- Fugitive losses can be dramatically reduced by implementing a directed inspection and maintenance program
  - Voluntary program to identify and fix leaks that are cost-effective to repair
  - Survey cost will pay out in the first year
  - Provides valuable data on leak sources with information of where to look

Source: Targa Resources

What is Directed Inspection and Maintenance?

- Directed Inspection and Maintenance (DI&M)
  - Cost-effective practice, by definition
  - Find and fix significant leaks
  - Choice of leak detection technologies
  - Strictly tailored to company's needs
- DI&M is NOT the regulated volatile organic compound leak detection and repair (VOC LDAR) program

Source: Targa Resources

How Do You Implement DI&M?

CONDUCT baseline survey

↓

SCREEN and MEASURE leaks

↓

FIX on the spot leaks

↓

ESTIMATE repair cost, fix to a payback criteria

↓

DEVELOP a plan for future DI&M

↓

RECORD savings/REPORT to Natural Gas STAR

How Do You Implement DI&M?

- Screening - find the leaks
  - Soap bubble screening
  - Electronic screening (“sniffer”)
  - Toxic vapor analyzer (TVA)
  - Organic vapor analyzer (OVA)
  - Ultrasound leak detection
  - Acoustic leak detection
  - Infrared leak detection

Toxic Vapor Analyzer

Acoustic Leak Detection

How Do You Implement DI&M?

- Evaluate the leaks detected - measure results
  - High volume sampler
  - Toxic vapor analyzer (correlation factors)
  - Rotameters

Leak Measurement Using a High Volume Sampler

How Do You Implement DI&M?

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

*** - Least effective at screening/measurement**

***** - Most effective at screening/measurement**

$ - Smallest capital cost

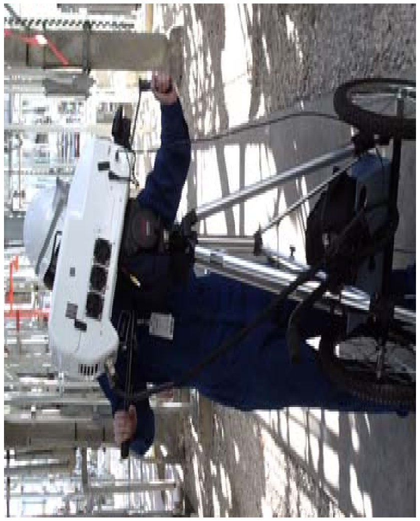
$$$ - Largest capital cost

Estimating Comprehensive Survey Cost

- Cost of complete screening using high volume sampler
  - Ranges $15,000 to $20,000 per medium size plant
  - Rule of Thumb: $1 per component for an average plant
- 25 to 40% cost reduction for follow-up survey

DI&M by Infrared Leak Detection

- Real-time detection of methane leaks
  - Quicker identification & repair of leaks
  - Screen hundreds of components an hour
  - Screen inaccessible areas simply by viewing them



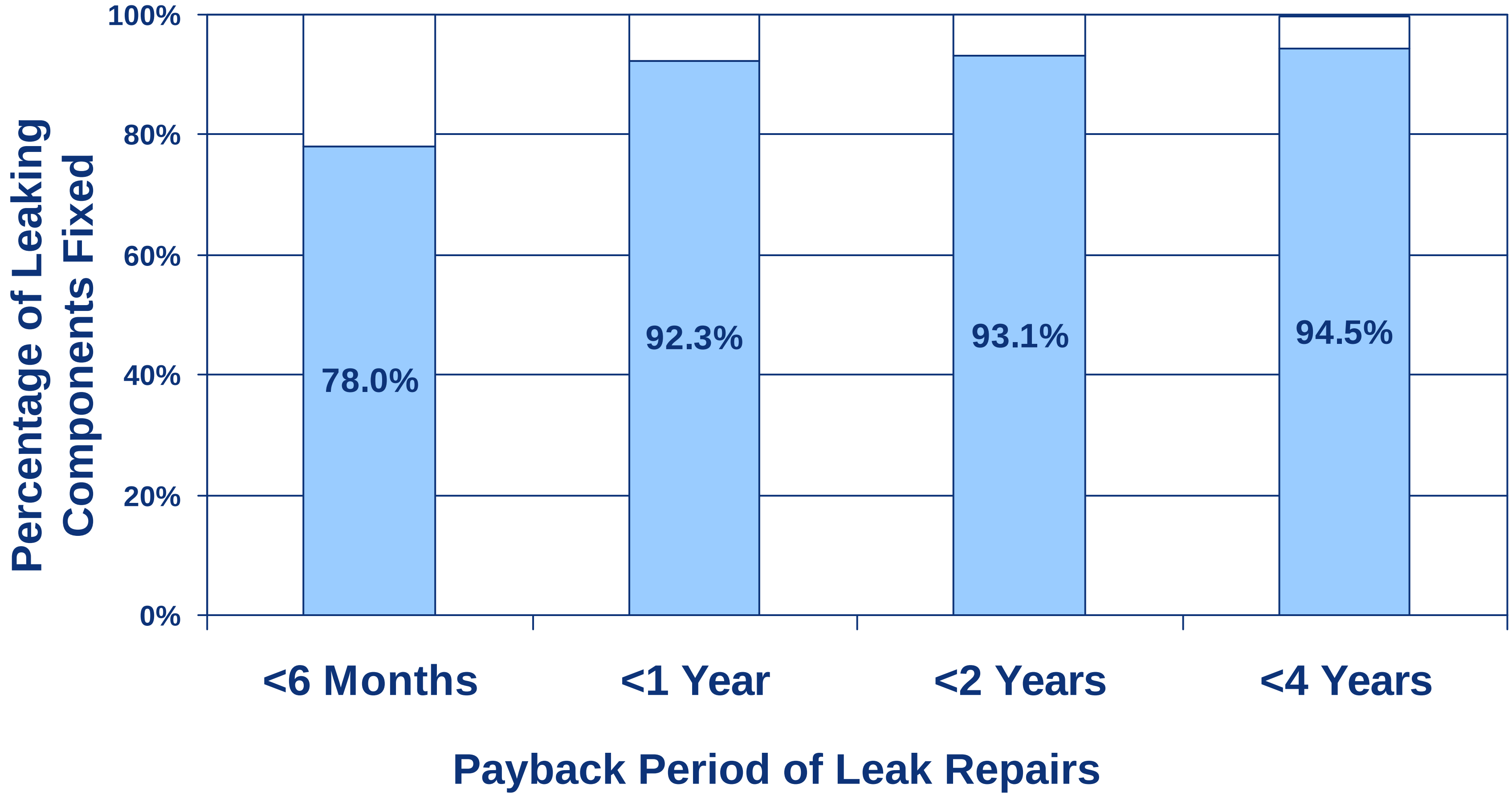
Infrared Methane Leak Detection

- Video recording of fugitive leaks detected by various infrared devices

Is Recovery Profitable?

Repair the Cost-Effective Components			
Component	**Value of Lost gas[1] ($)**	**Estimated Repair cost ($)**	**Payback (Months)**
Plug Valve: Valve Body	29,498	200	0.1
Union: Fuel Gas Line	28,364	100	0.1
Threaded Connection	24,374	10	0.0
Distance Piece: Rod Packing	17,850	2,000	1.4
Open-Ended Line	16,240	60	0.1
Compressor Seals	13,496	2,000	1.8
Gate Valve	11,032	60	0.1
Source: Hydrocarbon Processing, May 2002 [1]Based on $7/Mcf gas price			

Total Leak Reductions that are Cost-Effective to Find and Fix for Gas Plants



Economic Analysis of DI&M of OELs

Economics Analysis of DI&M of Open-Ended Lines at Large and Small Gas Plants[1]		
	Small	**Large**
Inspection of Plants OELs (Man-day/year)	**1**	**1**
Inspection of Booster OELs (Man-day/year)	**2**	**3**
Inspection Prep and Record (Man-day/year)	**NA**	**3**
Repairs & Maintenance (Man-days)	**1**	**2**
Labor Cost ($/day)	**500**	**500**
Total Labor Cost ($/year)	**2,000**	**4,500**
Methane Savings (Mcf/year)	**3,319**	**4,526**
Gas Savings (Mcf/year)[2]	**3,688**	**5,029**
Gas Saving Value ($/year)	**25,816**	**35,203**
Payback (year)	**<1**	**<1**

[1] Assumes two inspections per year

[2] Gas values based on $7/Mcf

DI&M - Lessons Learned

- A successful, cost-effective DI&M program requires measurement of the leaks
- A high volume sampler is an effective tool for quantifying leaks and identifying cost-effective repairs
- Open-ended lines, compressor seals, blowdowns, engine-starters, and pressure relief valves represent <3% of components but >60% of methane emissions
- The business of leak detection has changed dramatically with new technology

Source: Chevron/Unocal

Partner Experience - Targa Resources (formerly Dynegy)

- Surveyed components in two processing plants: 23,169 components
- Identified leaking components: 857 about 3.6%
- Repaired components: 80 to 90% of the identified leaking components
- Annual methane emissions reductions: 198,000 Mcf/year
- Annual savings: $1,386,000/year (at $7/Mcf)

Source: Targa Resources

Partner Experience - Chevron

- Chunchula, Alabama gas processing plant
  - Plant processes 37.5 MMcf/day
  - Survey conducted April 4 to 9, 2005
- Screening equipment
  - Soaping solution, sniffers, infrared camera
- Quantification
  - High volume sampler
- 17,000 components screened
  - 224 components (1.3%) were found to be leaking

Source: Chevron

Discussion

- Industry experience applying these technologies and practices
- Limitations on application of these technologies and practices
- Actual costs and benefits