Methane to Markets

Directed Inspection and Maintenance

Energy Management Workshop for Upstream and Midstream Operations

January 17, 2006

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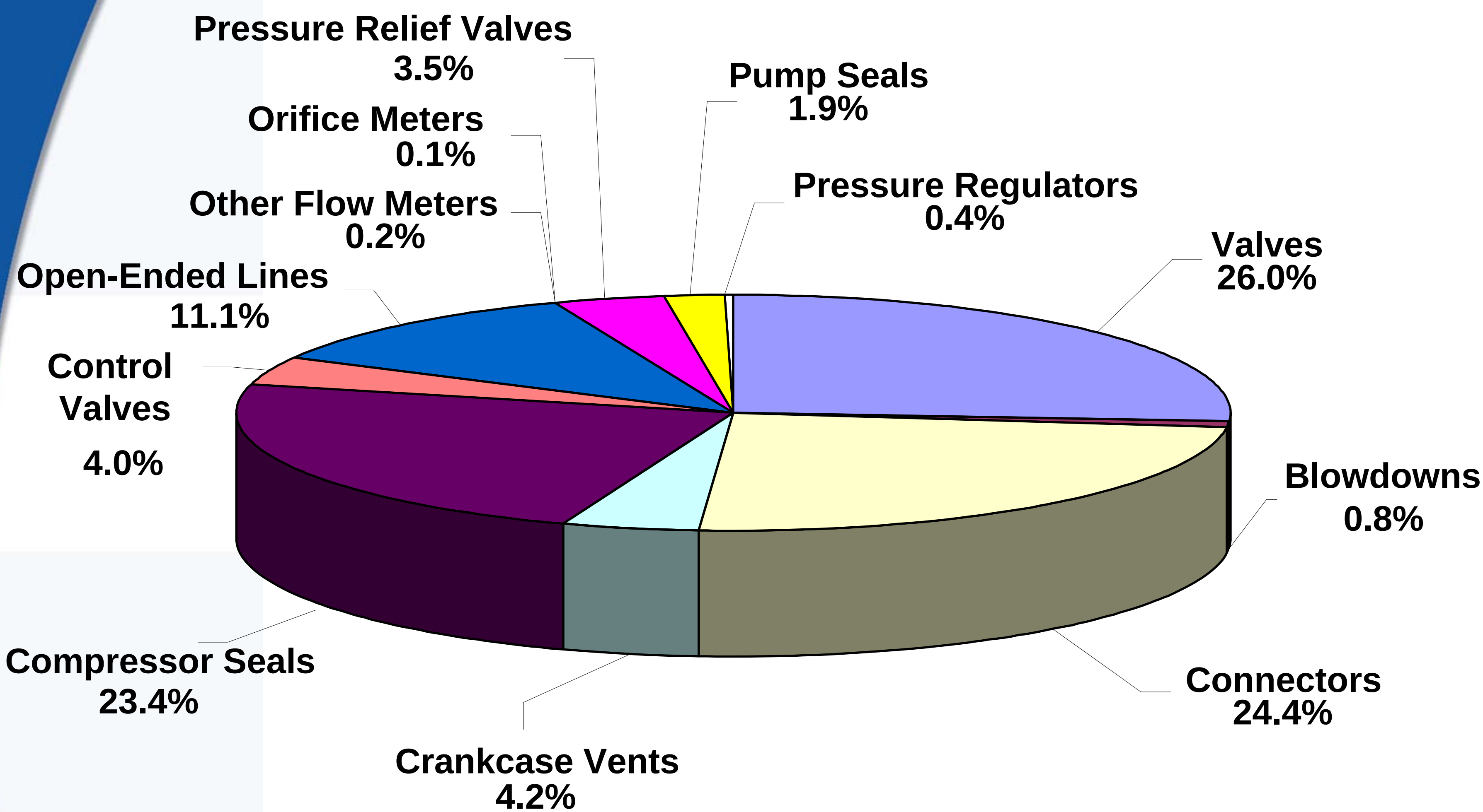
Directed Inspection and Maintenance (DI&M): Agenda

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

Methane Losses by Equipment Type



Source: Clearstone Engineering, 2002

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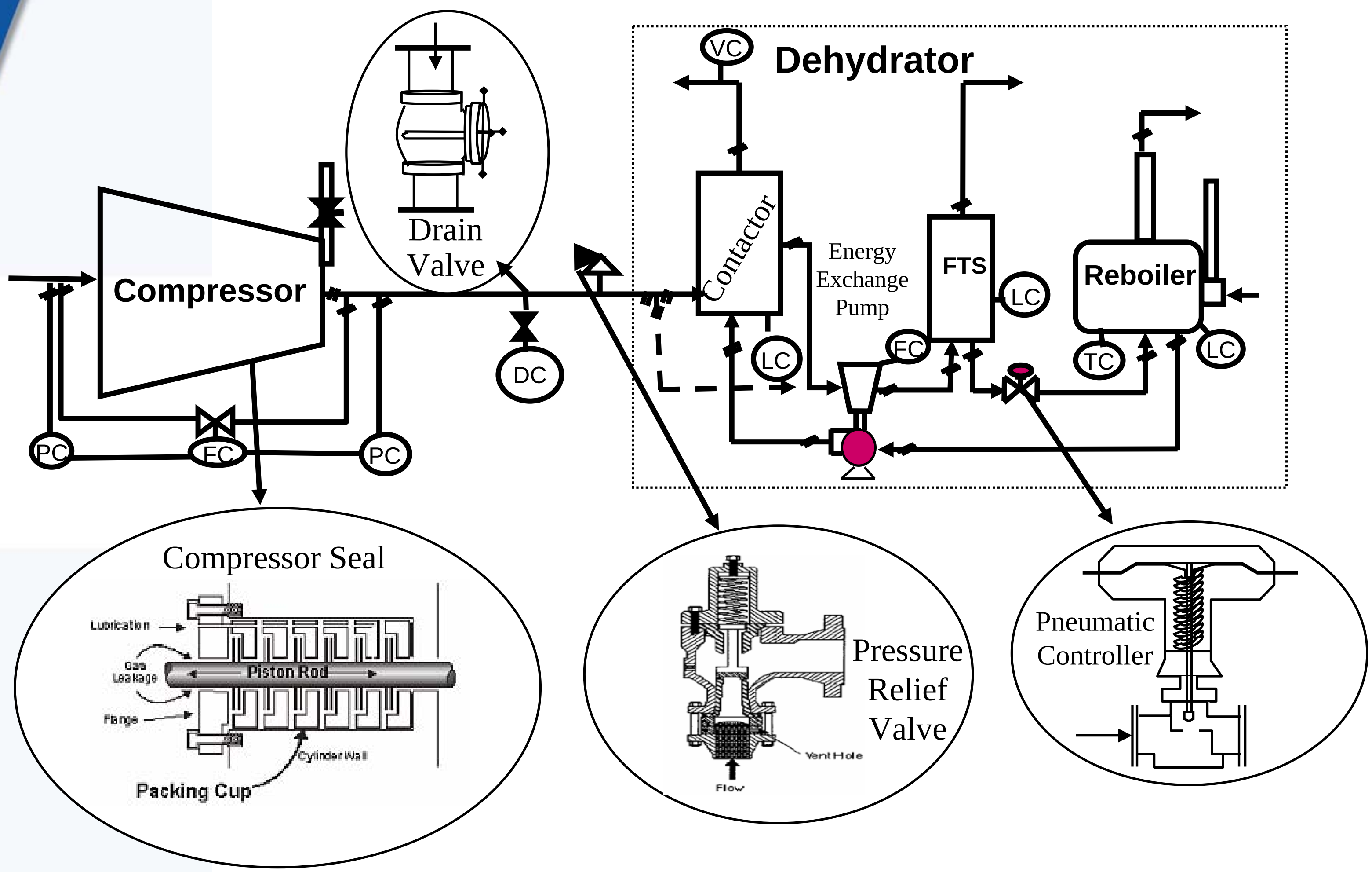
What is the Problem?

- Gas leaks are *<u>invisible</u>*, *<u>unregulated</u>* and *<u>go unnoticed</u>*
- Methane to Markets companies find that valves, connectors, compressor seals and open-ended lines (OELs) are major sources
  - 27 billion cubic feet (Bcf) of methane emitted per year by reciprocating compressors seals and OELs, each contributing equally to the emissions

What are the Sources of Emissions?



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How Much Methane is Emitted?

Methane Emissions from Leaking Components at Gas Processing Plants			
Component Type	**% of Total Methane Emissions**	**% Leakers**	**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.
Mcf = thousand cubic feet

How Much Methane is Emitted?

- A total of 101,193 components were screened at four processing plants

Summary of Natural Gas Losses from the Top Ten Leakers[1]				
Plant Number	Gas Losses From Top 10 Leakers (Mcf/day)	Gas Losses From All Equipment Leakers (Mcf/day)	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

Source: Clearstone Engineering, 2002,

Methane Recovery

- Fugitive losses can be dramatically reduced by implementing a DI&M 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 leakers with information of where to look

Soap Solution

What is DI&M?

- Direct Inspection and Maintenance
  - Cost-effective practice by definition
  - Find and fix significant leaks
  - Choice of leak detection technologies
  - Strictly tailored to company's needs

Acoustic Leak Detection

- DI&M is NOT a regulated volatile organic compound (VOC) leak detection and repair program (such as the US LDAR Program)

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 emissions reductions

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Screening and Measurement

Summary of Screening and Measurement Techniques		
Instrument/ Technique	**Effectiveness**	**Approximate Capital Cost**
Soap Solution	★★	$
Electronic Gas Detectors	★	$$
Acoustic Detection/ Ultrasound Detection	★★	$$$
Toxic Vapor Analyzer / Flame Ionization Detector	★	$$$
Bagging	★	$$$
High Volume Sampler	★★★	$$$
Rotameter	★★	$$
Leak Imaging	★★★	$$$
Source: EPA's Lessons Learned Study		

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

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

$ - Smallest capital cost

$$$ - Largest capital cost

DI&M Using Infrared Leak Detection

- Video recording of fugitive leaks found by various infrared leak detection technologies

How Do You Implement DI&M?

- Evaluate the leaks detected - measure results
  - High Volume Sampler
  - Toxic Vapor Analyzer and correlation factors
  - Rotameters
  - Calibrated bag
  - Engineering calculations

Leak Measurement Using a High Volume Sampler

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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

DI&M Lessons Learned

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

Industry Experience: Targa Resources (formerly Dynegy)

- Surveyed components in two processing plants: 23,169 components
- Identified leaking components: 857, or 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)

Discussion Questions

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

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