Partner Reported Offshore Methane Emissions Reduction Opportunities

Lessons Learned

from Natural Gas STAR

Offshore Technology Transfer Workshop

Shell, GCEAG, API, Rice University and

EPA's Natural Gas STAR Program

June 8, 2004

Offshore PROs: Agenda

- Introduction to Partner Reported Opportunities (PROs) and Lessons Learned
- Selected PRO Overviews
- DI&M
- DI&M Industry Experience
- Discussion Questions

Why Are Partner Reported Opportunities (PROs) Important?

- Partner Annual Reports document Program accomplishments
  - **BMPs: The consensus best practices**
  - **PROs: Partner Reported Opportunities**
- Simple vehicles for sharing successes and continuing Program's future
  - **Lessons Learned: Expansion on the most advantageous BMPs and PROs**
  - **PRO Fact Sheets**
  - **Technology Transfer Workshops**
  - **Posted on www.epa.gov/gasstar**

Why Are Partner Reported Opportunities (PROs) Important?

- Many production facilities have identified practical, cost-effective methane emissions reduction practices
- Production partners report saving 187 Bcf since 1990, 80% from PROs
- Vapor recovery units (VRUs) account for 30% of PRO emissions reductions

Gas STAR PRO Fact Sheets

- 14 PROs apply to offshore operations
  - **From 38 PROs applicable to production**
    - **12 focused on operating practices**
    - **26 focused on technologies**
- PRO Fact Sheets are derived from Annual Reports 1994-2002
  - **Total 56 posted PROs at epa.gov/gasstar/pro/index.htm**

Gas STAR Lessons Learned Studies

- 7 Lessons Learned studies are applicable offshore
  - **From 10 applicable to production**
    - **2 focused on operating practices**
    - **8 focused on technology**
- All 16 Lessons Learned studies are on Gas STAR web site
  - **www.epa.gov/gasstar/lessons.htm**

Lessons Learned
Studies for Offshore Operations

- Installing Vapor Recovery Units on Crude Oil Storage Tanks
- Optimize Glycol Circulation and Install Flash Tank Separators in Dehydrators
- Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry
- Convert Gas Pneumatic Controls to Instrument Air
- Reducing Emissions When Taking Compressors Off-Line
- Replacing Gas-Assisted Glycol Pumps with Electric Pumps
- Replacing Wet Seals with Dry Seals in Centrifugal Compressors

More Opportunities Reported by Partners

- Replace Gas Starters with Air
- Replace Ignition – Reduce False Starts
- Install Electric Starters
- Rerouting of Glycol Skimmer Gas
- Convert Gas-driven Chemical Pumps to Instrument Air
- Pipe Glycol Dehydrator to Vapor Recovery Unit
- Convert Pneumatics to Mechanical Controls
- Install Electronic Flare Ignition Devices
- Install Ejector
- Inspect & Repair Compressor Station Blowdown Valves
- Install BASO® Valves
- Use Ultrasound to Identify Leaks
- Test and Repair Pressure Safety Valves
- Begin DI&M at Remote Facilities

Examples of Technology Enabled PROs

- PROs enabled by instrument air system
  - **Replace Gas Starters with Instrument Air**
  - **Convert Gas-Driven Chemical Pumps to Instrument Air**
- PROs enabled by glycol dehydrators
  - **Reroute Glycol Skimmer Gas**
  - **Reroute Glycol Dehydrator to Vapor Recovery**
- PROs enabled by electric power
  - **Install Electric Starters**

Replace Gas Starters with Air

- What is the Problem?
  - **Pressurized gas used to start engines is exhausted to atmosphere**
- Partner Solution
  - **Replace gas with compressed air**
- Methane Savings
  - **Based on one 3,000 HP reciprocating compressor with 10 start-ups per year**
- Applicability
  - **All natural gas pneumatic starter motors**
  - **Needs electric power to run air compressor**

Methane Savings

1,356 Mcf/yr

Project Economics

Project Cost	**< $1,000**
Annual O&M Costs	**$100 - $1,000**
Payback	**< 1 yr**

Convert Gas-Driven Chemical Pumps to Instrument Air

- What is the Problem?
  - **Circulation pumps powered by pressurized natural gas vent methane**
- Partner Solution
  - **Replace natural gas with instrument air to power pumps**
- Methane Savings
  - **Based on one gas assisted glycol pump for a 10 MMcf/d gas dehydration unit**
- Applicability
  - **Can use surge capacity of existing instrument air system**
  - **Need electrical power if new instrument air compressor is installed**

Methane Savings

2,500 Mcf/yr

Project Economics

Project Cost	**$1,000 - $10,000**
Annual O&M Costs	**$100 - $1,000**
Payback	**< 1 yr**

PROs for Glycol Dehydrators

- Dehydrators present an excellent opportunity to reduce emissions
- How much methane is emitted?
  - **A 20 MMcf/d dehydrator with no flash tank separator (FTS) and a gas pump can produce 7,600 Mcf/yr of losses**
- How can these losses be reduced?
  - **Lots of choices…install a flash tank separator, convert gas pump to electric pump and adjust glycol circulation rate**

Reroute Glycol Skimmer Gas

- What is the Problem?
  - **Gas from condensate separator is vented to atmosphere**
- Partner Solution
  - **Reroute condensate separator gas for fuel use**
- Methane Savings
  - **Based on 20 MMcf/d dehydrator with no FTS, circulating 300 gph**
- Applicability
  - **All dehydrators with vent condensers**
  - **Small footprint**
  - **Condensate separator must operate at higher pressure than the gas destination**

Methane Savings

7,600 Mcf/yr

Project Economics

Project Cost	**<$1,000**
Annual O&M Costs	**$100 - $1,000**
Payback	**< 1 yr**

Pipe Glycol Dehydrator to Vapor Recovery

- What is the Problem?
  - **High pressure gas used to drive gas assist glycol pump is vented**
- Partner Solution
  - **Reroute gas from reboiler stack condenser vent to a VRU**
- Methane Savings
  - **Based on 10 MMcf/d gas dehydration unit with FTS, condenser and gas assist pump**
- Applicability
  - **Can use excess capacity of existing VRU**
  - **Small footprint**

Methane Savings

3,300 Mcf/yr

Project Economics

Project Cost	**$1,000 - $10,000**
Annual O&M Costs	**> $1,000**
Payback	**< 1 yr**

Install Electric Starters

- What is the Problem?
  - Pressurized gas used to start engines is exhausted to atmosphere
- Partner Solution
  - Replacing starter expansion turbine with electric motor starter
- Methane Savings
  - Based on one engine starter, ten start-ups per year and methane leakage through gas shut-off valve
- Applicability
  - All sectors of gas industry
  - Access to electrical power supply

Methane Savings

1,350 Mcf/yr

Project Economics

Project Cost	**$1,000 - $10,000**
Annual O&M Costs	**< $100**
Payback	**1- 3 yrs**

Directed Inspection & Maintenance

What is the Problem?

- Gas leaks are invisible, unregulated and go unnoticed
- STAR Partners find that valves, connectors, compressor seals and open-ended lines (OELs) are major sources
  - **27 Bcf methane 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

How Can These Losses Be Reduced?

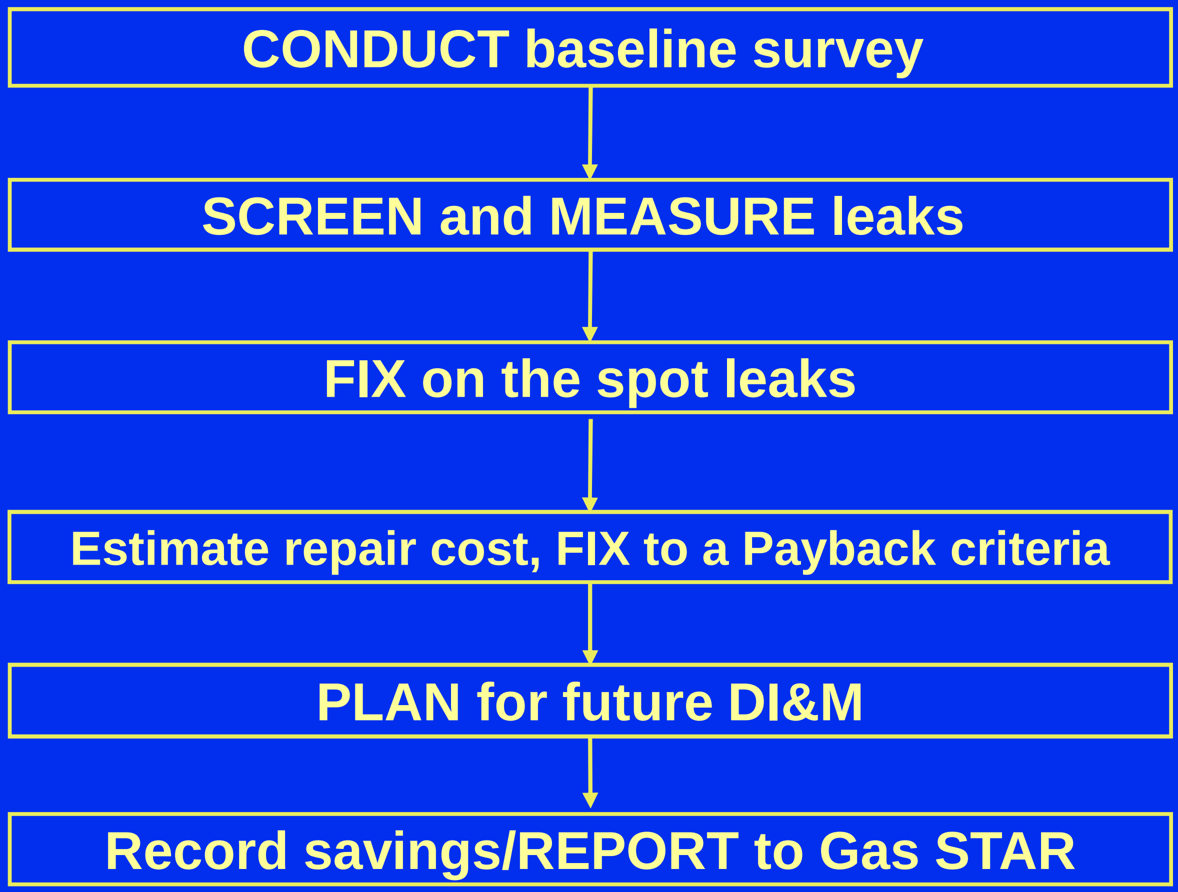
- Implementing a Directed Inspection and Maintenance (DI&M) Program

Source: CLEARSTONE ENGINEERING LTD

What is a DI&M Program?

- 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?



One of the Newer Operating Practices

- Begin Directed Inspection and Maintenance at Remote Facilities
  - **SAVES… 362 Mcf/yr**
  - **PAYBACK … < 1 yr**
- Enables several PROs
  - **Inspect and Repair Compressor Station Blowdown Valve**
  - **Use Ultrasound to Identify Leaks**
  - **Test and Repair Pressure Safety Valves**

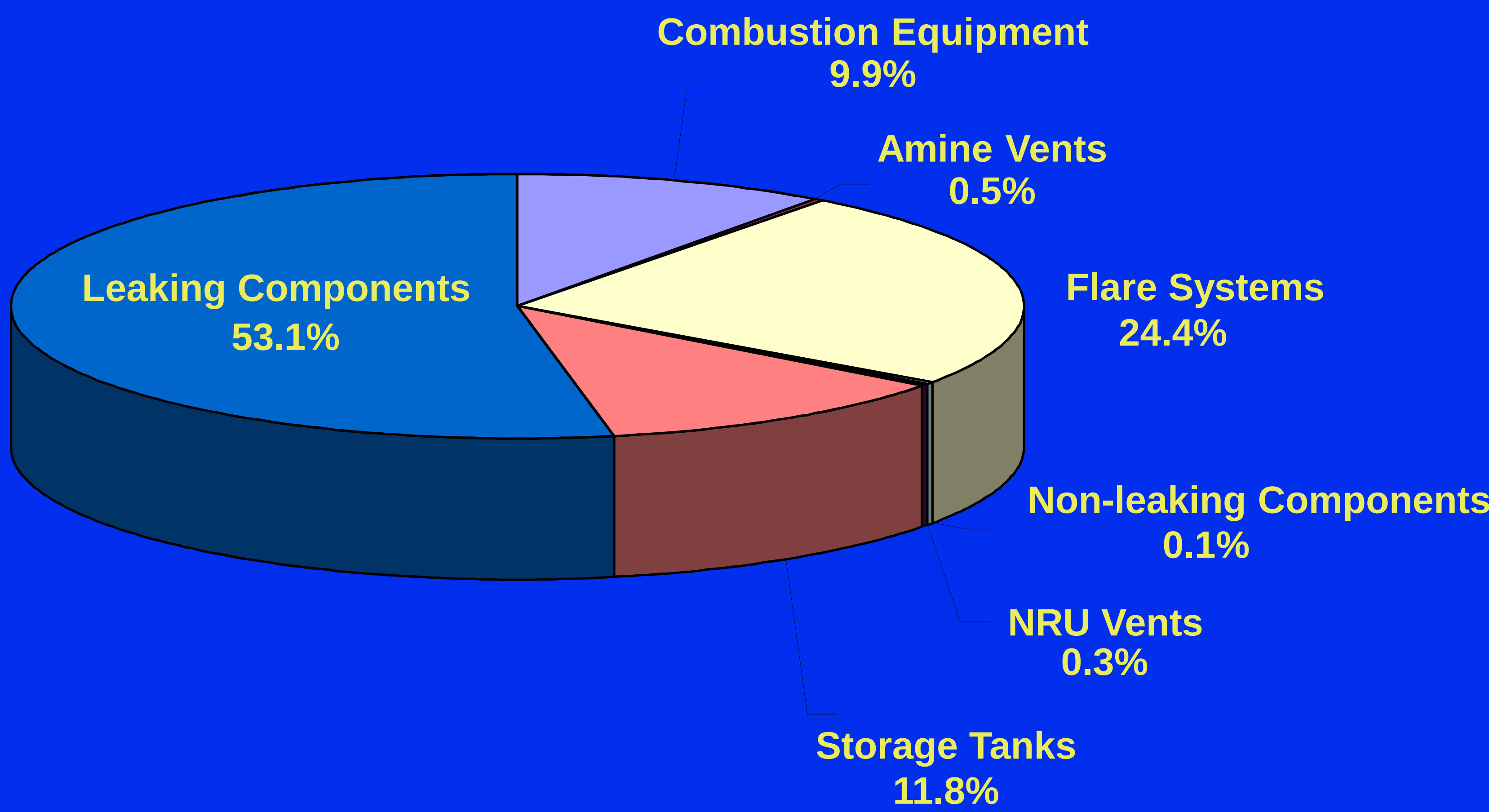
Bubble test on leaking valve

Source: CLEARSTONE ENGINEERING LTD

Screening and Measurement

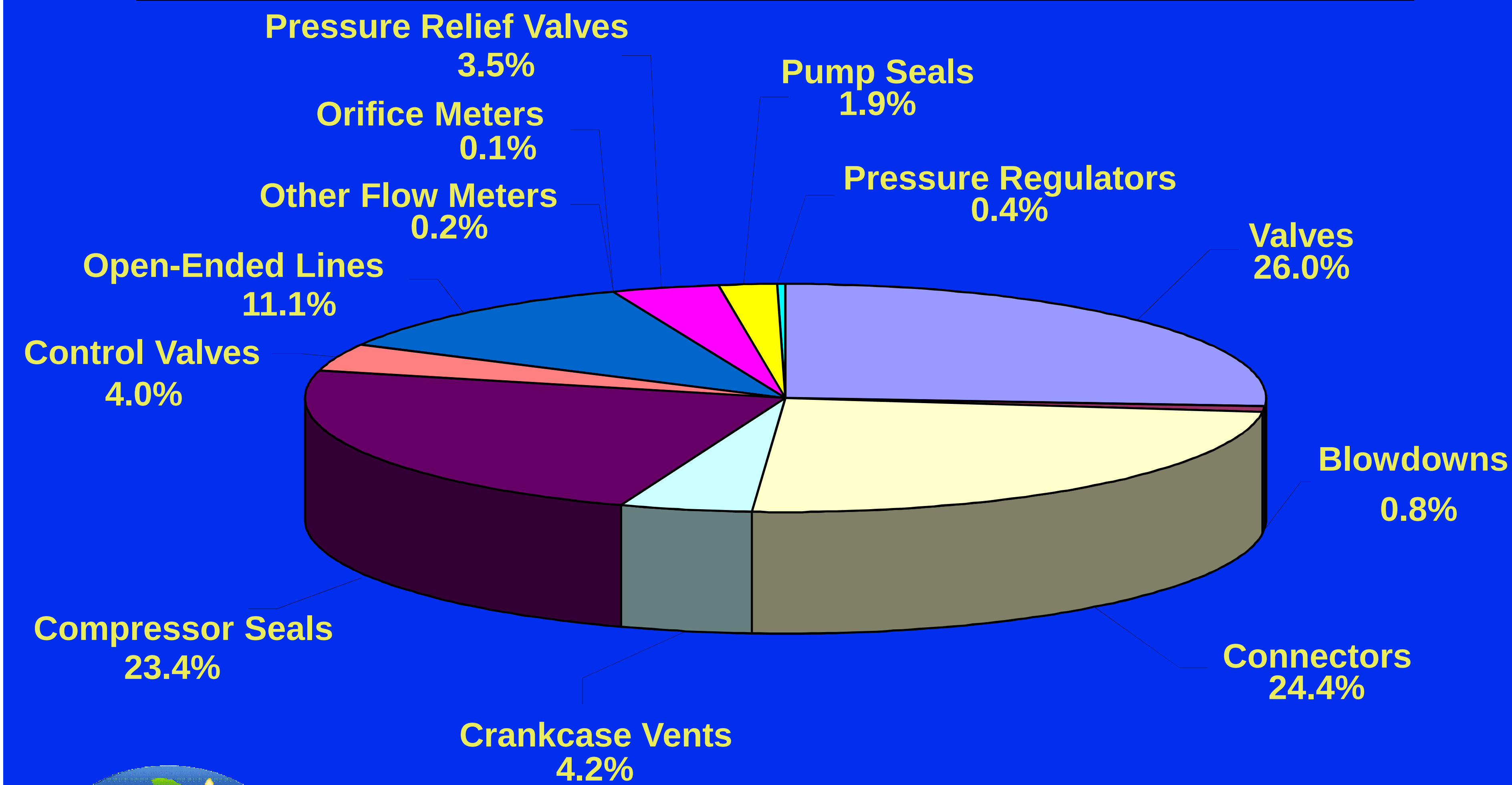
Summary of Screening and Measurement Techniques		
Instrument/ Technique	**Effectiveness**	**Approximate Capital Cost**
Soap Solution	★★	$
Electronic Gas Detectors	★	$$
Acoustic Detection/ Ultrasound Detection	★★	$$$
TVA (FID)	★	$$$
Bagging	★	$$$
High Volume Sampler	★★★	$$$
Rotameter	★★	$$
Source: EPA's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

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 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%	8.1%	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

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**: Leaking cylinder head was tightened, which reduced the methane emissions from almost 64,000 Mcf/yr to 3,300 Mcf/yr
  - **Repair required 9 man-hours of labor**
  - **Gas savings were approximately 60,700 Mcf/yr**
  - **Value of gas saved was $182,100/year at $3/Mcf**
- **Partner B**: One-inch pressure relief valve emitted almost 36,774 Mcf/yr
  - **Required five man-hours of labor and $125 of materials**
  - **Value of the gas saved was $110,300 at $3/Mcf**

DI&M - Partner Experience

- **Partner C**: Blowdown valve leaked almost 14,500 Mcf/yr
  - **Rather than replace the expensive valve, Partner spent just $720 on labor and materials to reduce the emissions to ~100 Mcf/yr**
  - **Value of gas saved was $43,200 at $3/Mcf**
- **Partner D**: Tube fitting leaked 4,121 Mcf/yr
  - **Very quick repair requiring only five minutes reduced leak rate to 10 Mcf/yr**
  - **Value of the gas saved was $12,300 at $3/Mcf**

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, focus, manpower, etc.) that are preventing you from implementing these practices?