Directed Inspection & Maintenance
At Compressor and Gate Stations

Lessons Learned
from Natural Gas STAR

NiSource and
EPA’s Natural Gas STAR Program
June 3, 2003
What is the Problem?

- Gas leaks are invisible, unregulated and go unnoticed
- STAR partners find that valves, connectors, compressors and open-ended lines (OEL) are major sources
  - 50.7 Bcf/yr of methane are emitted by compressors and facility components
  - 1% of the leakers contribute 90% of the emissions
- Fugitive emissions depend on operating practices, equipment age and maintenance
Distribution of Natural Gas Losses by Source Category

- Leaking Components: 53.1%
- Flare Systems: 24.4%
- Storage Tanks: 11.8%
- Non-leaking Components: 0.1%
- NRU Vents: 0.3%
- Amine Vents: 0.5%
- Combustion Equipment: 9.9%

Source: Clearstone Engineering, 2002
Natural Gas Losses from Equipment Leaks by Type of Component

- Control Valves: 4.0%
- Open-Ended Lines: 11.1%
- Other Flow Meters: 0.2%
- Orifice Meters: 0.1%
- Pressure Relief Valves: 3.5%
- Valves: 26.0%
- Blowdowns: 0.8%
- Connectors: 24.4%
- Compressor Seals: 23.4%
- Crankcase Vents: 4.2%
- Pump Seals: 1.9%
- Pressure Regulators: 0.4%

Source: Clearstone Engineering, 2002
How Much Methane is Emitted?

- **Study covered 13 Stations**
  - Average: 7 recip
  - Average: 2 turbines
  - Inlet: 500-700 psi
  - Outlet: 700-1,000 psi
  - 34,400 components tested
  - Average: 2,707 components per station

- **Findings**
  - 5% leakers or 135 components
  - 385-200,000 Mcf/yr total leakage rates
  - Average: 41,000 Mcf/yr

Source: 1999 EPA/GRI/PRCI Study
How Can These Losses Be Reduced?

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

AND of course, implementing other BMP’s and PRO’s!
How Do You Implement a DI&M Program?

1. CONDUCT Baseline survey
2. SCREEN and MEASURE leaks
3. FIX leaks on the spot
4. Estimate repair cost, fix to PAYBACK criteria
5. Develop a PLAN for future DI&M
6. Record savings/REPORT to Gas STAR
# How Do You Implement a DI&M Program?

## Summary of Screening and Measurement Techniques

<table>
<thead>
<tr>
<th>Instrument/Technique</th>
<th>Effectiveness</th>
<th>Approximate Capital Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soap Solution</td>
<td>★ ★</td>
<td>$</td>
</tr>
<tr>
<td>Electronic Gas Detectors</td>
<td>★</td>
<td>$$</td>
</tr>
<tr>
<td>Acoustic Detection/ Ultrasound Detection</td>
<td>★ ★</td>
<td>$$$</td>
</tr>
<tr>
<td>TVA (FID)</td>
<td>★</td>
<td>$$$</td>
</tr>
<tr>
<td>Bagging</td>
<td>★</td>
<td>$$$</td>
</tr>
<tr>
<td>High Volume Sampler</td>
<td>★ ★ ★</td>
<td>$$$</td>
</tr>
<tr>
<td>Rotameter</td>
<td>★ ★</td>
<td>$$</td>
</tr>
</tbody>
</table>

Source: EPA's Lessons Learned Study
# Cost-Effective Repair Examples

## Repair the Cost Effective Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Value of Lost gas(^1) ($)</th>
<th>Estimated Repair cost ($)</th>
<th>Payback (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug Valve: Valve Body</td>
<td>12,641</td>
<td>200</td>
<td>0.2</td>
</tr>
<tr>
<td>Union: Fuel Gas Line</td>
<td>12,155</td>
<td>100</td>
<td>0.1</td>
</tr>
<tr>
<td>Threaded Connection</td>
<td>10,446</td>
<td>10</td>
<td>0.0</td>
</tr>
<tr>
<td>Distance Piece: Rod Packing</td>
<td>7,649</td>
<td>2,000</td>
<td>3.1</td>
</tr>
<tr>
<td>Open-Ended Line</td>
<td>6,959</td>
<td>60</td>
<td>0.1</td>
</tr>
<tr>
<td>Compressor Seals</td>
<td>5,783</td>
<td>2,000</td>
<td>4.2</td>
</tr>
<tr>
<td>Gate Valve</td>
<td>4,729</td>
<td>60</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Source: Hydrocarbon Processing, May 2002

\(^1\)Based on $3/Mcf gas price
DI&M – Transmission Partner Experience

- Partner A: 15 Stations surveyed annually
  - Survey and repairs averaged $350/station
  - Methane savings averaged 11,067 Mcf/station
    - Total Gas Savings $ 498,030
    - Total DI&M Cost $ (5,250)
    - SAVINGS $ 492,780

- Partner B: 2 Stations surveyed quarterly
  - Survey costs $200/station
  - 24 leaks detected & repaired; 23 repaired at average $50 each
    - Total Gas Savings $ 51,240
    - Total DI&M Cost $ (2,750)
    - SAVINGS $ 48,490
DI&M – Distribution Partner Experience

Partner C: 86 Stations surveyed
- Repairs made to 66 of 105 leaks found
- Gas savings totaled 1,519 Mcf, with net savings averaging $50 per facility surveyed
  - Total Gas Savings $ 6,557
  - Survey Costs $ (1,700)
  - Repair Costs $ (753)
  - Savings $ 4,104

Partner D: surveyed 306 facilities
- Repaired 824 leaks, four described as “large”
- Gas savings totaled 117,800 Mcf, 143 Mcf per leak
  - Total Gas Savings $ 353,430
  - Total DI&M Costs $ (16,500)
  - Net Savings $ 336,930
Related Studies and PRO Fact Sheets

- **Lessons Learned Studies**
  - DI&M at Compressor Stations
  - DI&M at Gate Stations and Surface Facilities
  - DI&M at Gas Processing Plants and Booster Stations

- **PRO Fact Sheets**
  - DI&M at Remote Facilities
Discussion Questions

- To what extent are you implementing this practice?
- Do you have other best practice opportunities to improve on this practice?
- How could these Lessons Learned studies be improved upon or altered for use in your operation(s)?
- What are the barriers (technological, economic, lack of information, regulatory, etc.) that are preventing you from implementing this practice?