

A man wearing a white hard hat with a logo, sunglasses, and a blue jacket is working on industrial equipment. He is holding a handheld device. The background shows a field and utility poles.

# Experience With Leak Detection and Measurement at Transmission and Distribution Facilities

**A Best Management Practice for Directed Inspection and Maintenance Programs**

**Milton W. Heath III  
Heath Consultants Incorporated  
Monday, March 15, 2010**



*Reducing Emissions, Increasing Efficiency, Maximizing Profits*

# Agenda

1. Technology for Leak Screening and Quantification of Fugitive Methane Emissions
2. Natural Gas Distribution Experience
3. Natural Gas Transmission Experience



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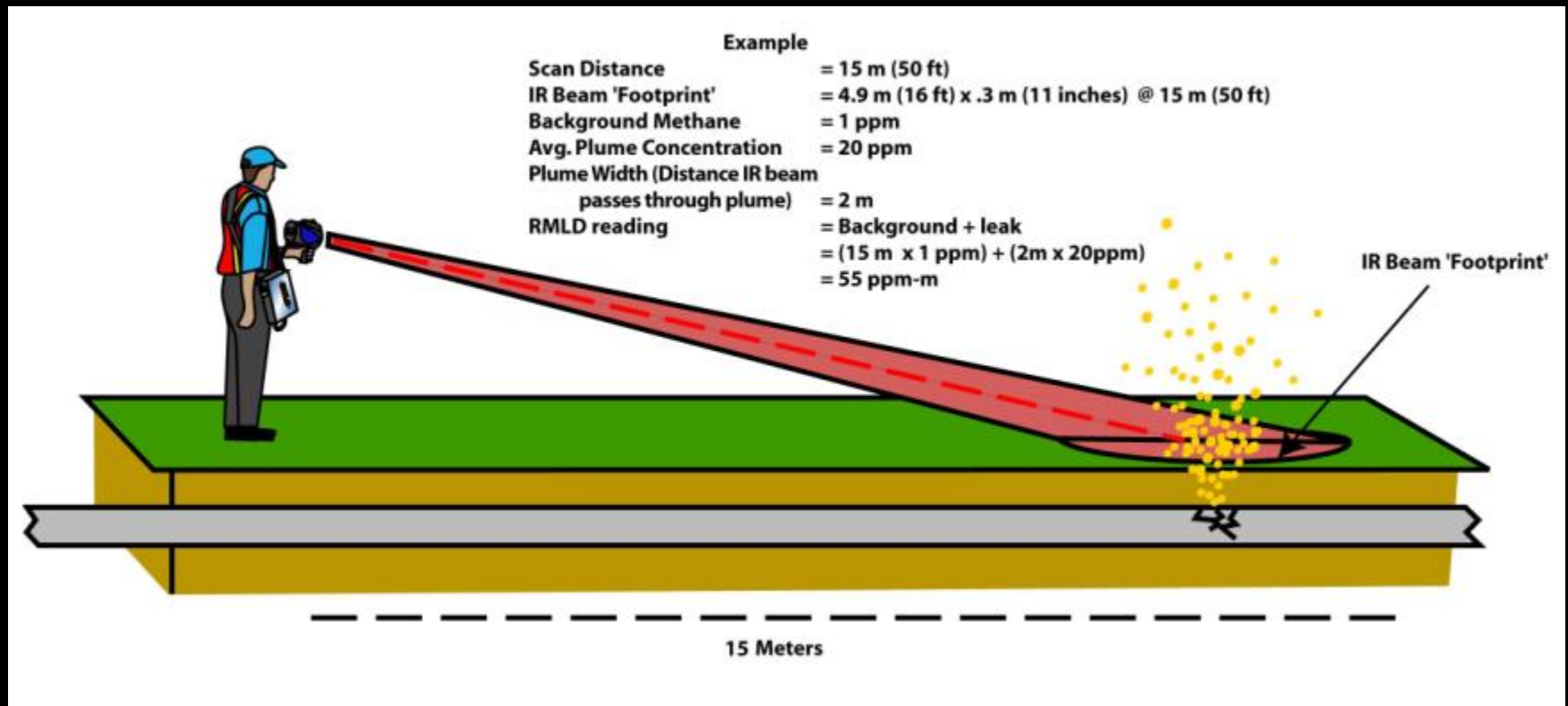
# RMLD

Remote Methane Leak Detector



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# How Does the RMLD Measure Gas?





Pump Driven CGI



Ultrasonic

# Measurement / Quantification of Hydrocarbon Emissions

- For leaks up to 10 cfm – Hi Flow Sampler  
10.5 cfm @ \$5/Mcf = \$27,594  
**Hi Flow Sampler Cost = \$18,800**



- For leaks 10 – 240 cfm – Vent-Bag Method  
50 cfm @ \$5/Mcf = \$131,400  
100 cfm @ \$5/Mcf = \$262,800  
**Calibrated Vent Bag Cost = \$90**



- For leaks >180 cfm – Anamometer
  - Used only on vertical open ended line
  - Much more subjective, requires experience.



# Hi Flow Sampler Applications



## Advantages:

- Total Leak Capture
- Measures Leak Rate Directly
- Accuracy of Calculated Leak Rate =  $\pm 5\%$  of reading
- Can Measure 30 components per hour
- Repair Decision Based on Leak Rate & Repair Costs

# Hi Flow Sampler Technology

- Captures Entire Leak
  - Measures Flow Rate (F) and Concentration (sample)
  - Subtracts the background (back) Concentration
  - Leak Rate =  $F \times (\text{sample} - \text{back})$





# Calibrated 3 Cubic Foot Measurement Bag

## Three Cubic Foot Anti-Static Measurement Bag



### Description:

The largest emissions observed at compressor stations are typically from open ended lines (2" to 12" I.D.) that are used as vents for blow down valves, unit valves, scrubber dump valves, pressure relief valves and rod packing systems. Some of the largest leaks from these vents occur when compressors are blown down and the blow down valve is open, allowing leaks across the suction and discharge block valves to vent through the blow down line. For scrubber dump valves, large leakage can occur after valve actuation when dirt and debris get caught in the valve seat allowing high pressure gas to leak through the unclosed valve to the condensate tank and then vented to open atmosphere. Unchecked compressor rod packing systems can leak substantial amounts of gas when running or idle because of several contributing factors which typically go unnoticed. It is under these conditions, we have measured leaks as large as 240 scfm of natural gas. To make measurements on leaks of this magnitude, we have fabricated calibrated bags of anti-static plastic of various sizes with a special neck to fit over vent openings. This allows a low-pressure drop measurement of vented systems that may not tolerate significant backpressure. The use of these "Vent-Bags" has been calibrated in our laboratory against rotameter measurements and been found accurate to within  $\pm 10\%$ . Given proper training while observing strict safety guidelines, this technique for measuring large natural gas leaks can be safe, expedient and affordable.

Please contact a representative from Heath's Professional Services Division for further information about this product.

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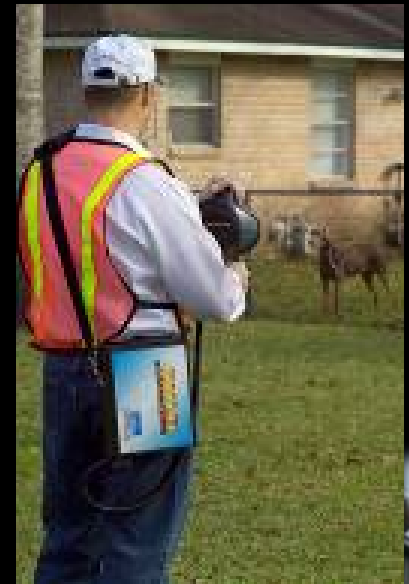
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# Leak Detection and Repair at Metering and Regulator Stations

- Systematic leak detection and repair at metering and regulator stations must be approached differently than at compressor stations and processing plants
  - Lower pressures, smaller leaks
  - Fewer components per site
- Some US companies elect to conduct leak screening only
  - Forego leak measurement to reduce survey costs
  - Fix all leaks that are identified
  - Survey is low cost but does not collect data on leak rates and gas savings
    - This information is needed to determine which leaks are cost-effective to repair



# JI/CDM Industry Experience: Distribution Companies in Russia and CIS Countries

- Leak Reduction from Natural Gas Distribution Regulator Stations using AM0023.



## Common Emission Sources at Distribution Metering and Regulator Stations

- Study of Former Soviet Union metering and regulator stations revealed common leaking components
  - Relatively small component counts per station

<b>Component Category</b>	<b>Number of Components Surveyed</b>	<b>Total number of Leaks Found</b>	<b>Total Leak Rate</b>	<b>Emission Factor (LPM)</b>	<b>Annual Emission Factor (Tonnes C02E)</b>
<b>Valve Stems</b>	<b>1008</b>	<b>248</b>	<b>671</b>	<b>0.66</b>	<b>4.7</b>
<b>Flanges</b>	<b>1697</b>	<b>120</b>	<b>510</b>	<b>0.30</b>	<b>2.12</b>
<b>Thread Connectors</b>	<b>2168</b>	<b>195</b>	<b>260</b>	<b>0.12</b>	<b>0.85</b>
<b>Turn Valves</b>	<b>468</b>	<b>25</b>	<b>50</b>	<b>0.10</b>	<b>0.75</b>
<b>Tubing Connectors</b>	<b>534</b>	<b>54</b>	<b>53</b>	<b>0.10</b>	<b>0.71</b>

**Source: Heath Consultant Inc.**

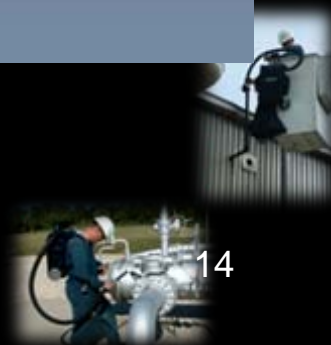
# Valve Stem Packing Replacement

- Replacing valve stem packing is a common leak repair activity at distribution gate stations and surface facilities
- GORE-TEX valve stem packing is one option for replacement
  - Polytetrafluoroethylene material (no asbestos)
  - Chemical resistant, pH 0 - 14
  - -268°C to 315°C



# Valve Stem Packing Replacement: Oblgas System Experience (Russian)

- Oblgas Joint Implementation (JI) Project
  - Methane Emissions Avoidance in the Tula Gas Distribution Network
- Project Description
  - All valves screened and inspected for leaks
  - Replace all (leaking and non-leaking) valve stem packing with GORE-TEX packing
  - Use GORE-TEX packing for all new valve installations



# Valve Stem Packing Replacement: Oblgaz System Experience (Russian)

- Project results
  - A system can have 10,000 - 75,000 valves
  - Leaking valves in region averaged 6 LPM or 3,000 M3/year or approximately 42 Tonnes CO2E/Year.
  - Expected Project Reductions for Valves only = 420,000 – 3,000,000 in Annual Emission Reduction Units.



# 3 Main Categories of Leaks

- Standardized Components
  - Flange, Union, Thread & Tube Fittings, valve caps, fuel injector valves, stem packing leaks etc...
- Compressor Seal Systems
  - Rod Packing Vent or Combined Distance Piece and Packing Vent, Wet or Dry Seal Vents on Turbines
- Blow Down Systems
  - Unit Valves, Blow Down Valves, Pressure Relief Valves, Power Gas Vent, Condensate Tanks, ESD Vents





# Top 4 Typical Fugitive Sources

- Reciprocating Compressor Packing
- Blow Down Valves
- Unit Valves
- Scrubber Dump Valves

“Find The Needle In The Haystack”



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# Partner Experience

## Midwest Compressor Station

	Component Category	Leak Rate (scfh)	Leak Rate (Mcf/Yr) <sup>[1]</sup>	Leak Rate (\$/Yr) <sup>[2]</sup>
Leak Rate from Standard Components	Standard	390	3,415	\$20,492
Leak Rate from Compressor Packings [Units 1-5]	Rod Packing	12,585	63,869	\$383,216
Leak Rate from Blowdown System (Unit Valves/Blowdown Valves/Pressure Relief Valves)	Blow Down System	520	4,552	\$27,310
<b>Total =</b>		<b>13,495</b>	<b>71,836</b>	<b>\$431,018.00</b>

<sup>[1]</sup> Takes into account engine activity factors tracked by station personnel.

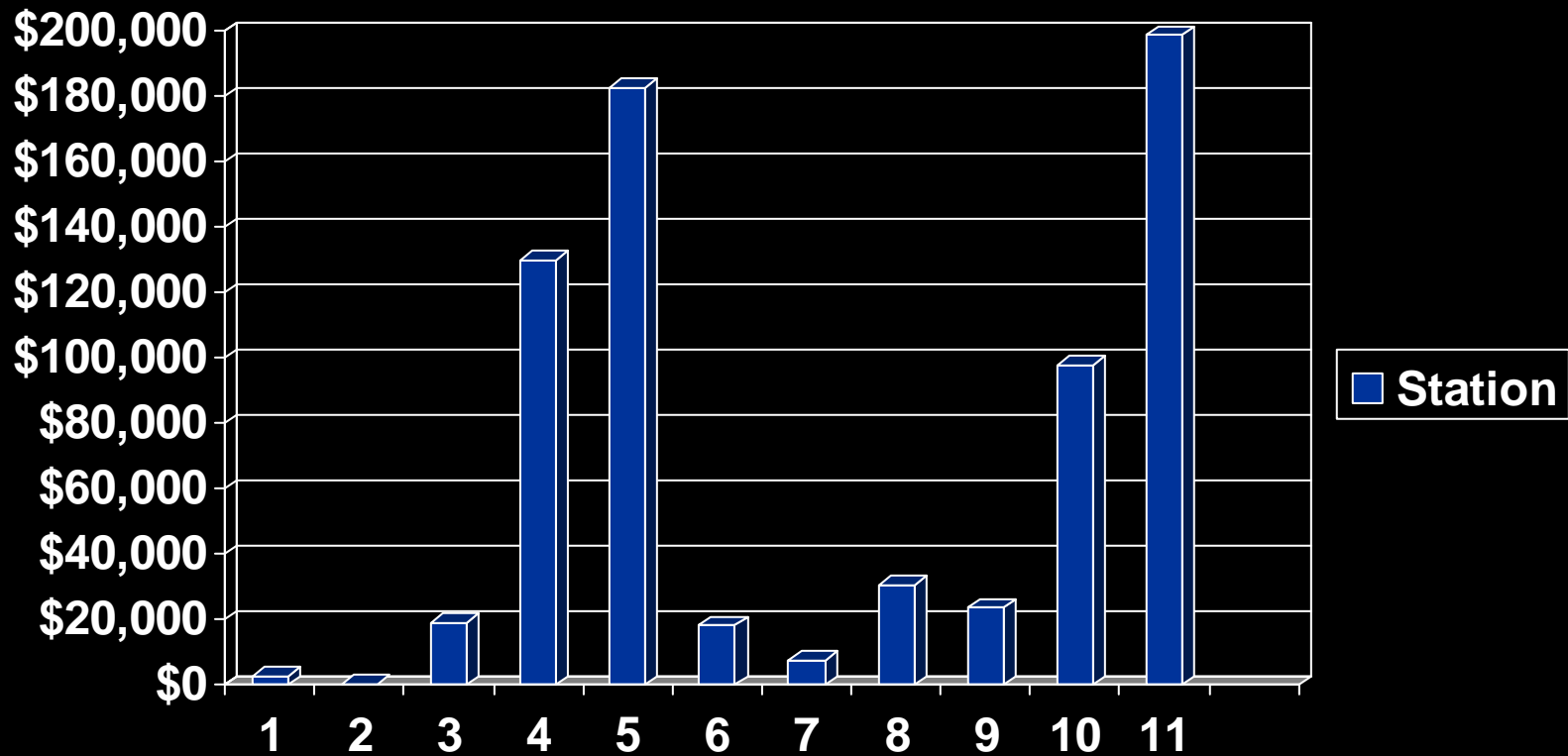
<sup>[2]</sup> Cost of Gas = \$6/Mcf

Source of Data: Heath Consultants



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# Typical Pipeline Compressor Station Profile



Assumes a cost of \$3/Mcf



# Survey Results from Leak Inspection and Quantification at 11 Compressor Stations

Number of Facilities	Number of Engines	Number of Leaks found	Total Emissions Measured	Total Gas @\$3/Mcf	Top 10 % of Largest Leaks (25 leaks)
11	50	257	237,467 Mcf	\$712,401	180,425 Mcf Or \$541,275 Or 75%

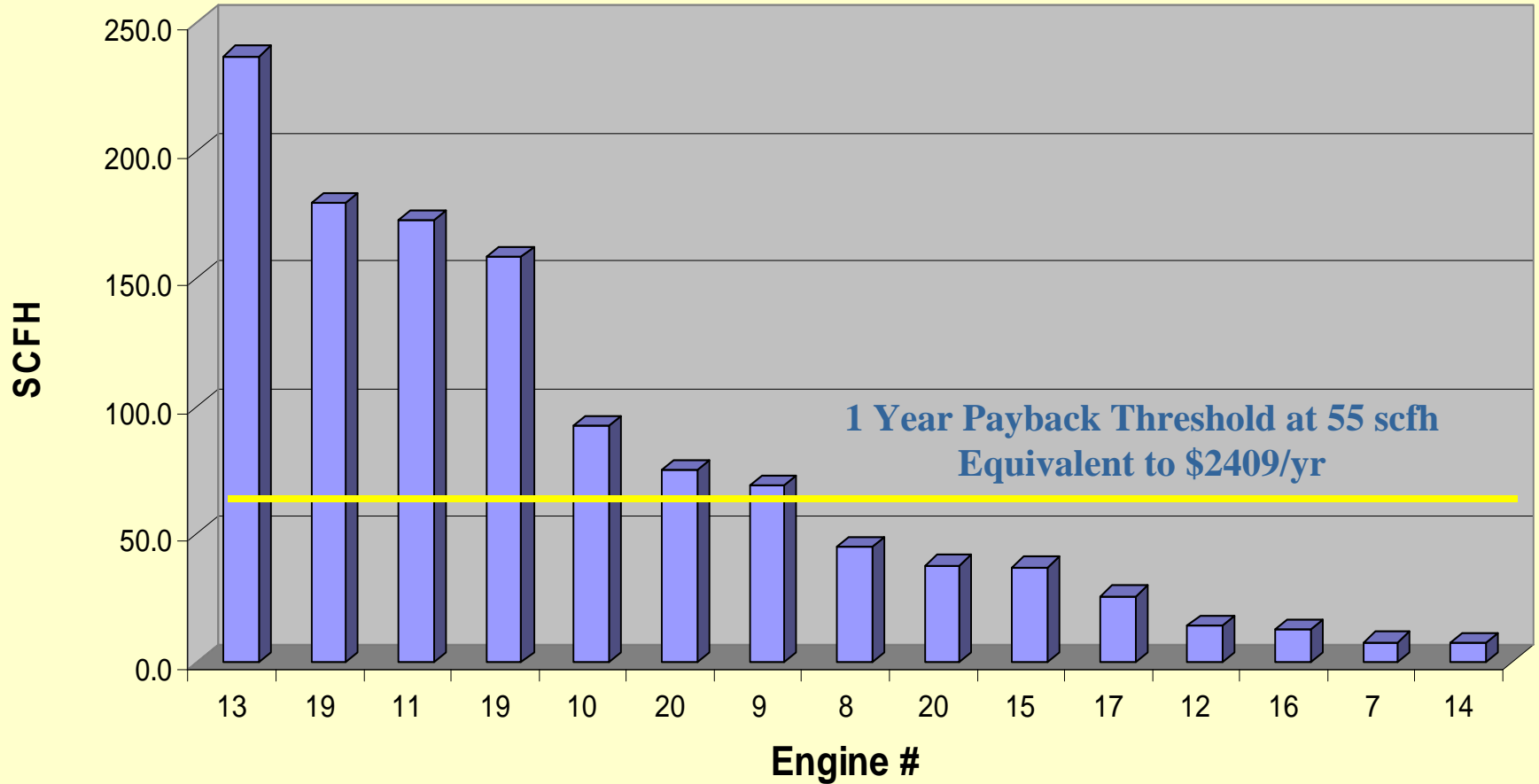


# About Rod Packing Leakage

- Under best conditions leak rate can be expected at a minimum of 11.5 scfh
- Leakage can be reduced through proper monitoring and a cost effective schedule for replacing packing rings & piston rods.
- Step one is to monitor and record baseline packing leakage and piston rod wear.
- Establish a replacement threshold



## Rod Packing Leak Rates at Oklahoma Compressor Station

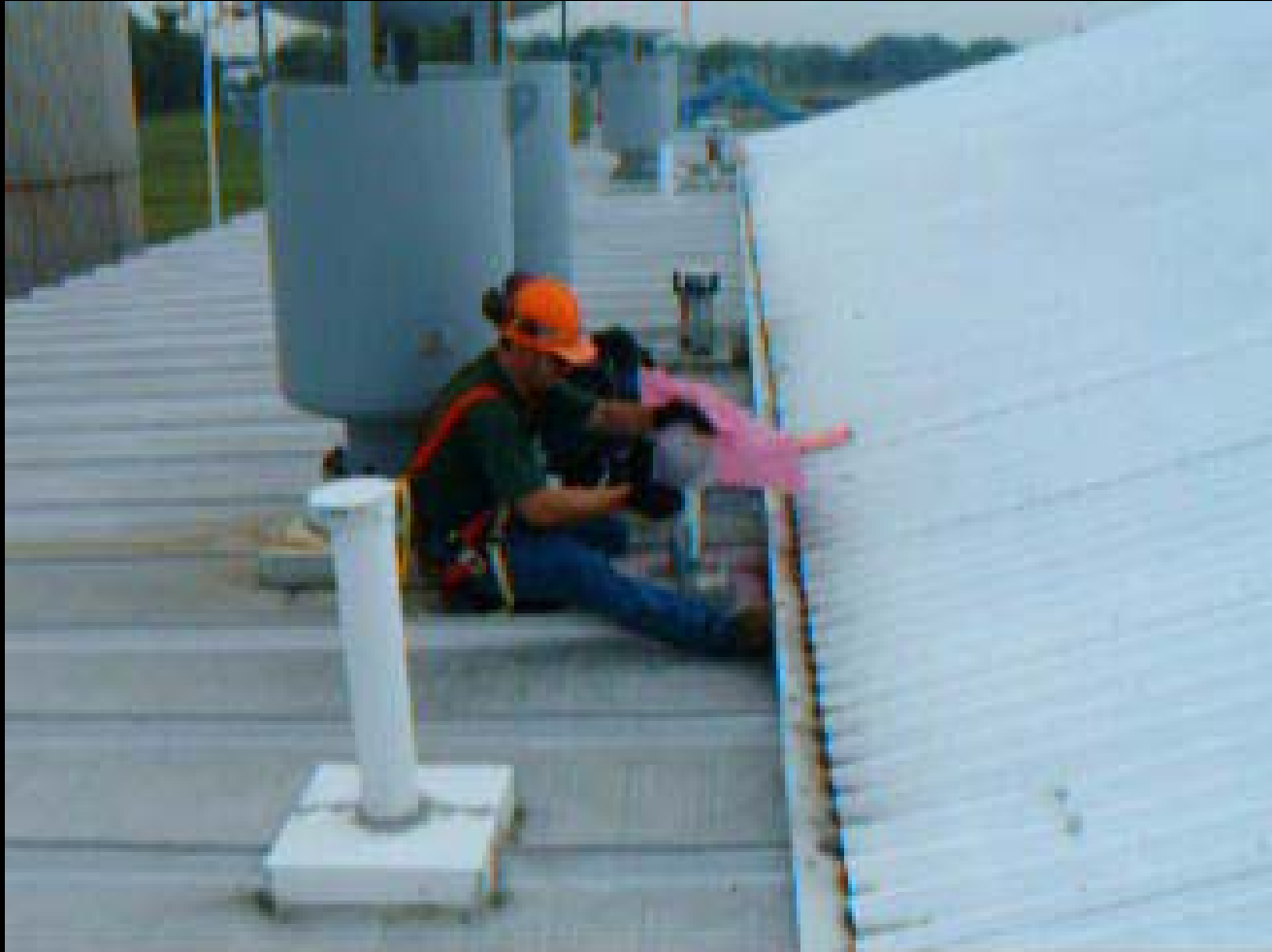


Gas = \$5/Mcf



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# Rod Packing Leakage



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# Natural Gas Scrubber Tanks





# Condensate Tank Leakage Identified Loses/Savings



**Estimated Annual Loss  
with 3 CFM Anti-Static  
Measurement Bag**

**13,515 Mcf/yr**

**Or**

**\$67,575Yr @ \$5/Mcf**



# Leaking Scrubber Dump Valve at Compressor Station

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**Leaking Scrubber Dump Valve Closed Manually  
Reducing Leakage by an estimated >300 scfm.**

**Estimated  
Savings =  
\$1,419,120/year**

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# Routine Monitoring of known culprits and plan for future DI&M



# Annual Station Monitoring Program

- Inspect significant leaks identified from recent survey and verify repairs remain intact.
- Inspect all critical components for new leakage
  - Compressor Packings
  - Unit Valves, Blowdown Valves, Dump Valves
- Spot check yard for leaks



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# Questions?



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