Reducing Emissions When Taking Compressors Off-line

Lessons Learned

from Natural Gas STAR

Transmission Technology Transfer Workshop

Duke Energy Gas Transmission,

Interstate Natural Gas Association of America (INGAA) and

EPA's Natural Gas STAR Program

September 22, 2004

Taking Compressors Off-line: Agenda

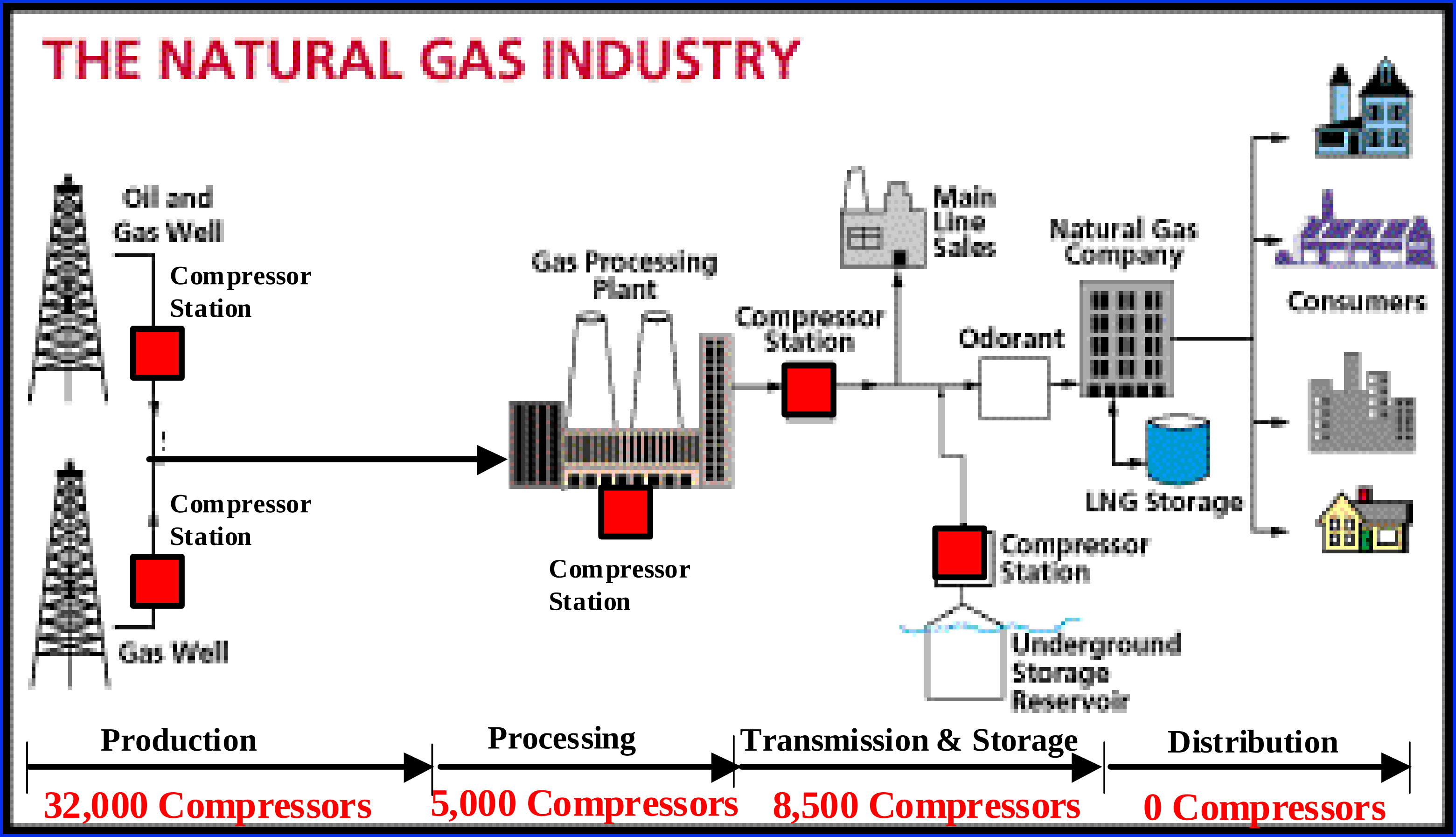
- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions

Methane Losses

- There are about 1,600 compressor stations in the U.S. transmission sector
  - **~8,500 compressors**
- 49.6 billion cubic feet (Bcf) per year is lost from compressor fugitives
- 7.0 Bcf per year is lost from compressor venting

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2002

Location and Types of Compressors

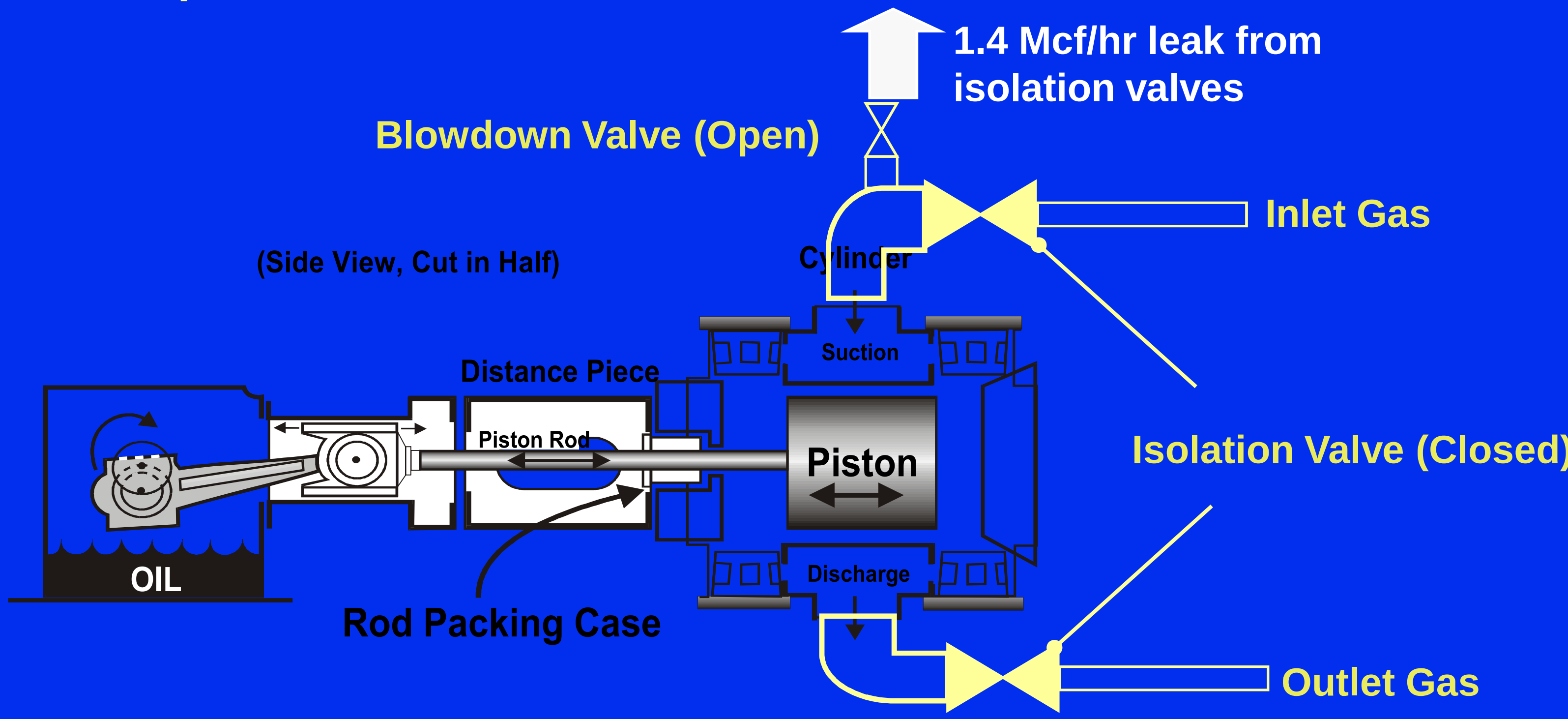


What is the Problem?

- Natural gas compressors cycled on- and off-line to match fluctuating gas demand
  - **Peak and base load compressors**
- Standard practice is to blow down (depressurize) off-line compressors
  - **One blowdown vents 15 Mcf gas to atmosphere on average**
- Isolation valves
  - **Leak about 1.4 Mcf/hr on average through open blowdown vents**

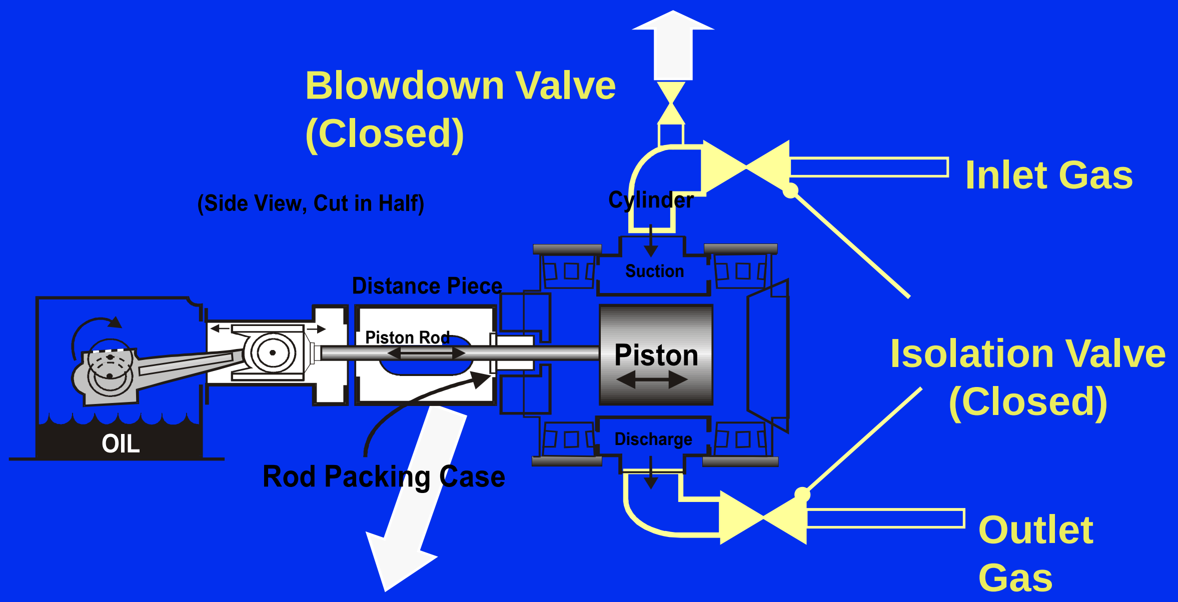
Basic Compressor Schematic

- Depressurized



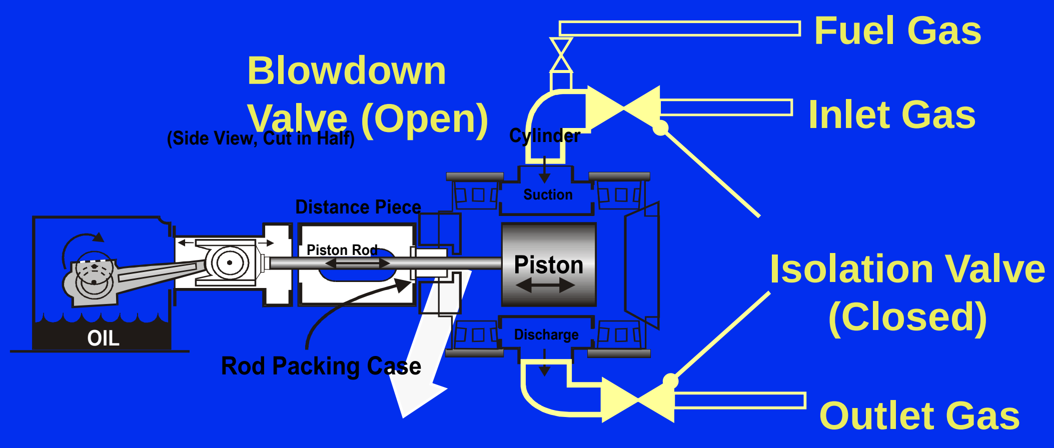
Methane Recovery - Option 1

- Keep off-line compressors pressurized
  - **Requires no facility modifications**
  - **Eliminates methane vents**
  - **Seal leak higher by 0.30 Mcf/hr**
  - **Reduces fugitive methane losses by 0.95 Mcf/hr (68%)**



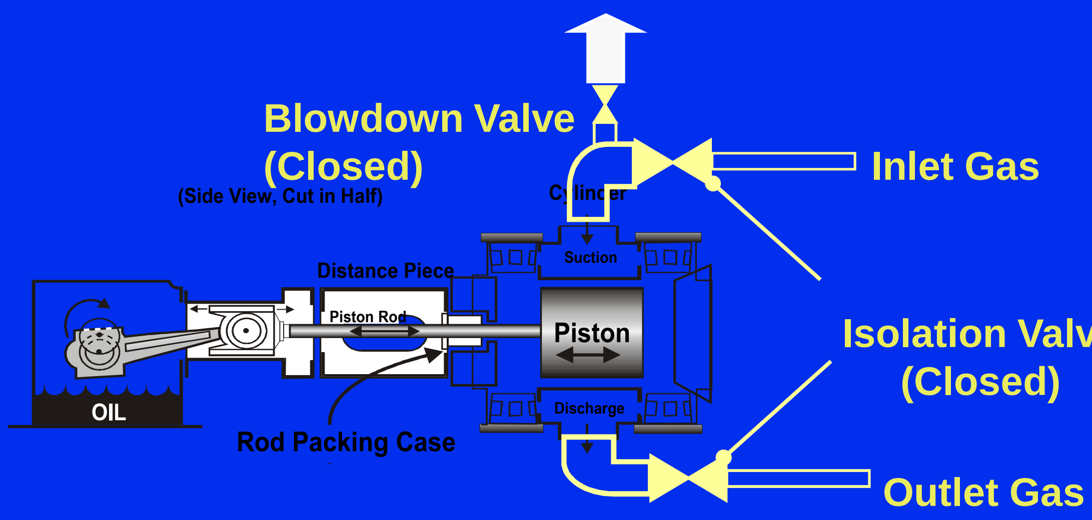
Methane Recovery - Option 2

- Route off-line compressor gas to fuel
  - **Connect blowdown vent to fuel gas system**
  - **Off-line compressor equalizes to fuel gas pressure (100 to 150 pounds per square inch)**
  - **Eliminates methane vents**
  - **Seal leak higher by 0.125 Mcf/hr**
  - **Reduces fugitive methane losses by 1.275 Mcf/hr (91%)**



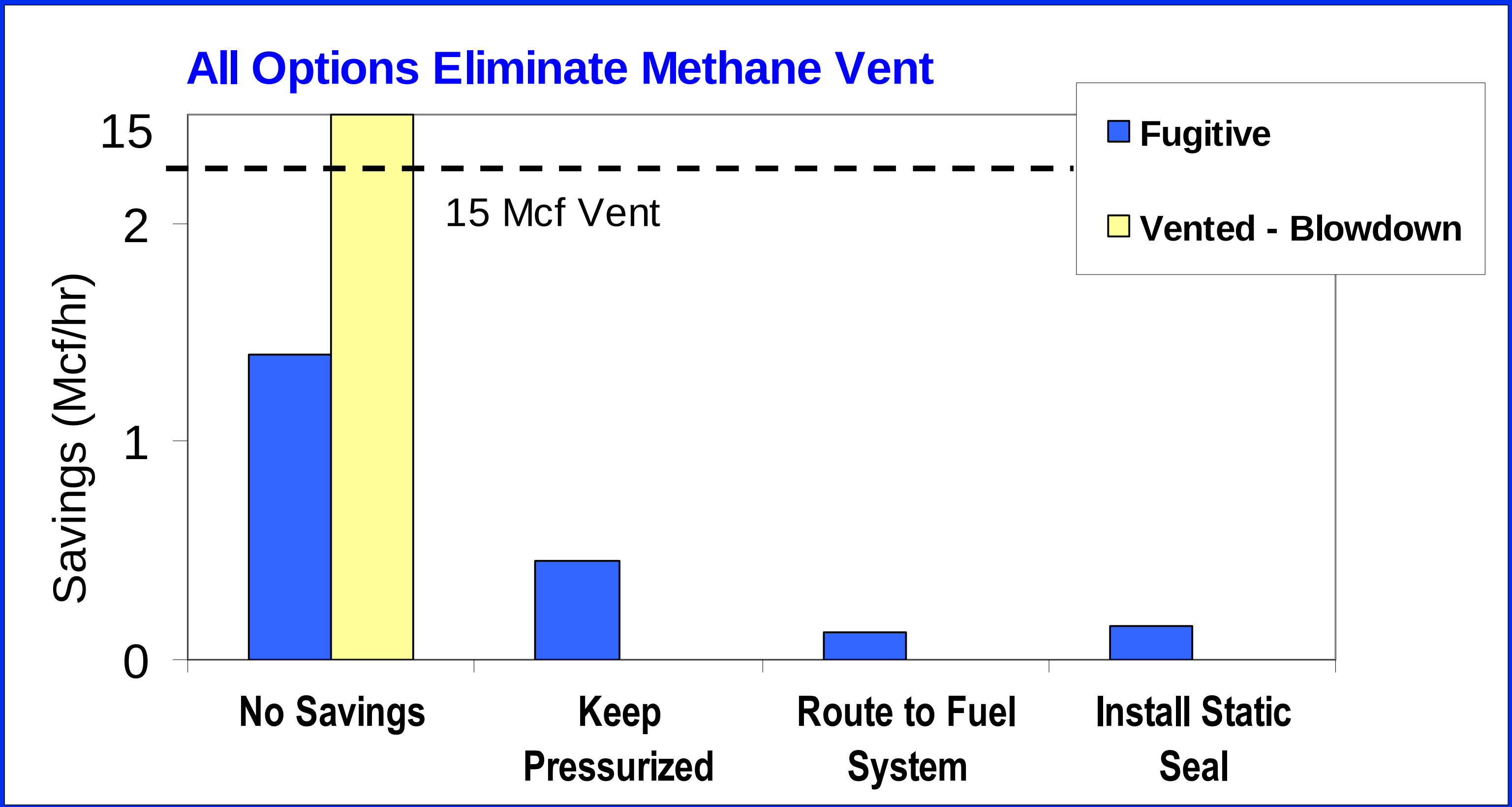
Methane Recovery - Option 3

- Keep pressurized and install a static seal
  - **Automatic controller activates rod packing seal on shutdown and removes seal on startup**
  - **Closed blowdown valve leaks**
  - **Eliminates leaks from off-line compressor seals**
  - **Reduces fugitive methane losses by 1.25 Mcf/hr (89%)**



Methane Recovery Options

- Methane savings comparison



Calculate Methane Emissions

- Blowdown losses = (# blowdowns) x (15 Mcf)[1]
- Fugitive losses = (# offline hours) x (1.4 Mcf/hr)[1]

- Total losses = blowdown + fugitive savings

- Example:
  - **2 blowdowns/yr x 15 Mcf**
  - **1,752 offline hours x 1.4 Mcf/hr = 2,500 Mcf/yr**

[1]EPA default values

Calculate Costs

- Option 1: Do not blow down
  - **No capital costs**
  - **No O&M costs**
- Option 2: Route to fuel gas system
  - **Add pipes and valves connecting blowdown vent to fuel gas system**
  - **Upgrade costs range from $900 to $1,600 per compressor**

Calculate Costs

- Option 3: Do not blow down and install static seal
  - **Seals cost $500 per rod**
  - **Seal controller costs $1,000 per compressor**
  - **Less cost-effective in conjunction with option 2**

Is Recovery Profitable?

- Costs and Savings

Capital Costs and Savings of Reduction Options

	Option 1: Keep Pressurized	**Option 2: Keep Pressurized and Tie to Fuel Gas**	**Option 3: Keep Pressurized and Install Static Seal**
Capital Cost	None	$1,250/compressor	$3,000/compressor
Off-line Leakage Savings			
Baseload	475 Mcf/yr $1,425	638 Mcf/yr $1,913	625 Mcf/yr $1,875
Peak Load	3,800 Mcf/yr $11,400	5,100 Mcf/yr $15,300	5,000 Mcf/yr $15,000

Baseload assumes 500 hours offline per year; Peak Load assumes 4,000 hours offline per year.
Gas cost = $3/Mcf. This table does not include blowdown savings.

Economic Analysis

- Economic comparison of options

Comparison of Options - Base Load Compressors

	Facilities Investment	Dollar Savings	Payback	IRR
Option 1	$0	$1,425	Immediate	>100%
Option 2	$1,250	$1,913	<1 yr	56%
Option 3	$3,000	$1,875	<1 yr	>100%

Assuming $3/Mcf, 5 year life

Economic Analysis

- Peak load options more economical due to more blowdowns and offline time

Comparison of Options - Peak Load Compressors

	Facilities Investment	Dollar Savings	Payback	IRR
Option 1	$0	$11,400	Immediate	>100%
Option 2	$1,250	$15,300	<1 yr	>100%
Option 3	$3,000	$15,000	<1 yr	>100%

Assuming $3/Mcf, 5 year life

Industry Experience

- One Partner connected blowdown vent to fuel gas system during scheduled off-line maintenance
  - **3,022 cylinders (577 compressors)**
  - **40% operating factor**
  - **1,580,000 Mcf/yr gas savings**

Lessons Learned

- Avoid depressuring whenever possible
  - **Immediate benefits with no investment**
- Educate field staff about benefits
- Identify compressor loads to conduct economic analysis
- Develop schedule for installing fuel gas routing systems
- Record savings at each compressor

Discussion Questions

- To what extent are you implementing these technologies?
- How can the Lessons Learned study be improved upon or altered for use in your operation(s)?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing this technology?