Natural Gas STAR International: An Overview of Compressor Emission Reduction Best Practices

Natural Gas STAR International
Meeting with Turkmenistan

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Farmington, New Mexico

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ICF International

Agenda

- 2009 U.S. Methane Emissions from Compressors
- Reciprocating Compressor Rod Packing
  - Methane Losses
  - Solution and Economics
- Contacts and Further Information

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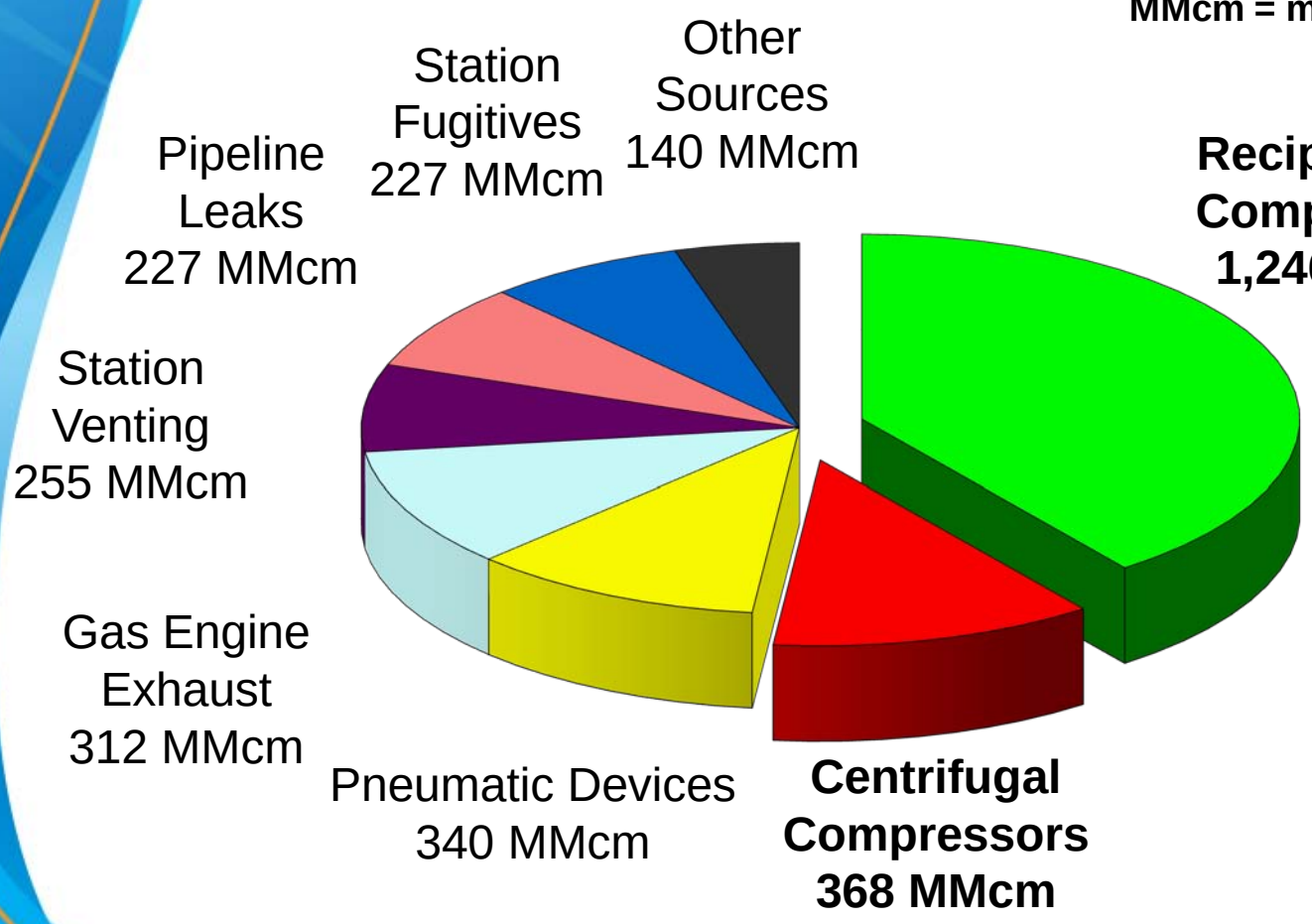
2009 U.S. Transmission Sector Methane Emissions from Compressors

MMcm = million cubic meters



Total Methane Emissions from Compressors = 1,614 MMcm 52% of gas transmission

EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2009.* April, 2011. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html.

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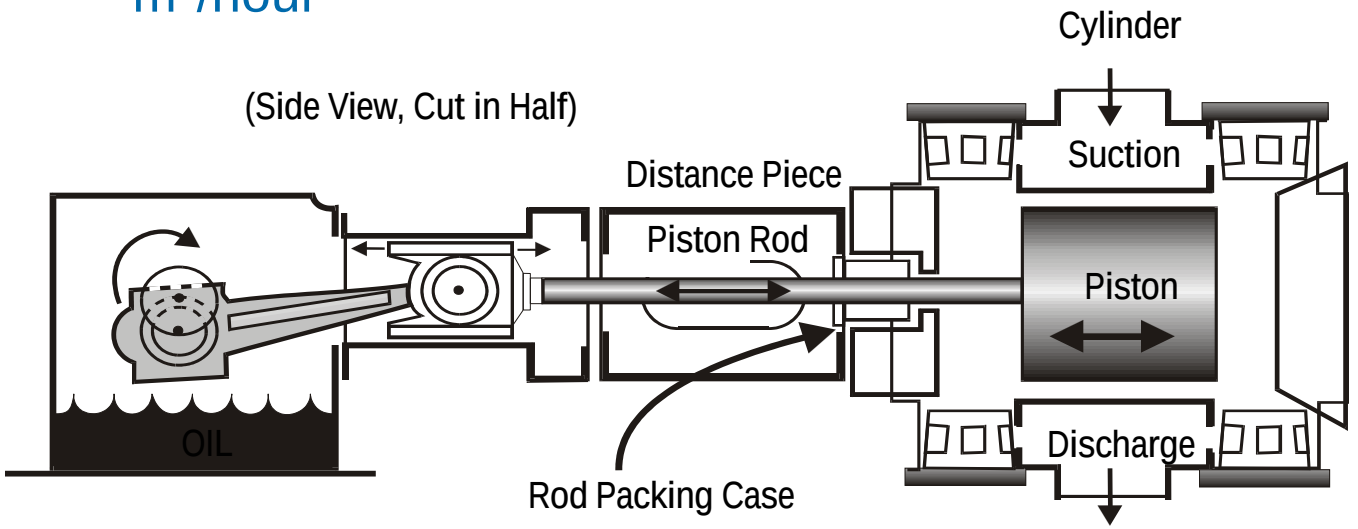
Methane Losses from Reciprocating Compressors

- Reciprocating compressor rod packing leaks some gas by design
  - Newly installed packing may leak 0.3 to 1.7 m^3/hour
  - Worn packing has been reported to leak up to 25.5 m^3/hour



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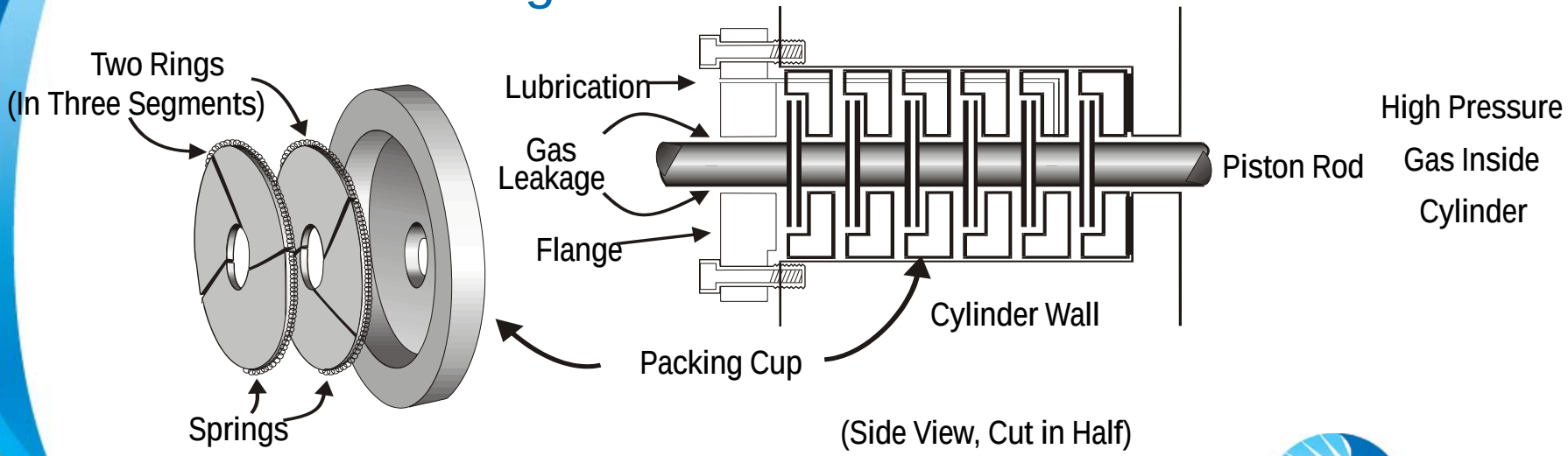
Reciprocating Compressor Rod Packing

- A series of flexible rings fit around the shaft to prevent leakage
- Leakage may still occur through nose gasket, between packing cups, around the rings, and between rings and shaft



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Impediments to Proper Sealing

Where packing case can leak

- Nose gasket
- Packing to rod
- Packing to cup
- Packing to packing
- Cup to cup

What makes packing leak?

- Dirt or foreign matter (trash)
- Worn rod (.015 mm/per cm diameter)
- Insufficient/too much lubrication
- Packing cup out of tolerance (≤ 0.05 mm)
- Improper break-in on startup
- Liquids (dilutes oil)
- Incorrect packing installed (backward or wrong type/style)

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Methane Losses from Rod Packing

Emission from Running Compressor	24,600	m^3/year-packing
Emission from Idle/Pressurized Compressor	36,000	m^3/year-packing
Leakage from Packing Cup	19,500	m^3/year-packing
Leakage from Distance Piece	8,500	m^3/year-packing

Leakage from Rod Packing on Running Compressors

Packing Type	Bronze	Bronze/Steel	Bronze/Teflon	Teflon
Leak Rate (m^3/year)	17,300	15,700	37,300	5,900

Leakage from Rod Packing on Idle/Pressurized Compressors

Packing Type	Bronze	Bronze/Steel	Bronze/Teflon	Teflon
Leak Rate (m^3/year)	17,400	N/A	36,500	5,400

Source: Cost Effective Leak Mitigation at Natural Gas Transmission Compressor Stations – PRCI/ GRI/ EPA PR-246-9526

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Solution: Economic Replacement

- Measure rod packing leakage
  - When new packing installed–after worn-in
  - Periodically afterwards
- Determine cost of packing replacement
- Determine economic replacement threshold
  - Partners can determine economic threshold for all replacements
  - This is a capital recovery economic calculation
- Replace packing when leak reduction expected will pay back cost

Economic Replacement Threshold (m^3/hour) =

$$\frac{CR * DF * 1{,}000}{(H * GP)}$$

Where:

CR = Cost of replacement (TMT)
DF = Discount factor at interest *i*
H = Hours of compressor operation per year
GP = Gas price TMT/thousand cubic meters)

$$DF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

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Contacts and Further Information

- More detail is available on these practices and over 80 others online at: epa.gov/gasstar/tools/recommended.html
- For further assistance, direct questions to:

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