Reducing Methane Emissions in Natural Gas Production

Turkmenistan Symposium on Gas Systems Management: Methane Mitigation

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Reducing Production Sector Emissions: Agenda

- **U.S. Production Sector Methane Emissions**
  - Methane losses
- Liquids Unloading
  - Plunger lifts
  - Methane savings
  - Is recovery profitable?
  - Industry experience
- Natural Gas Storage Reduction Opportunities

Source: BP

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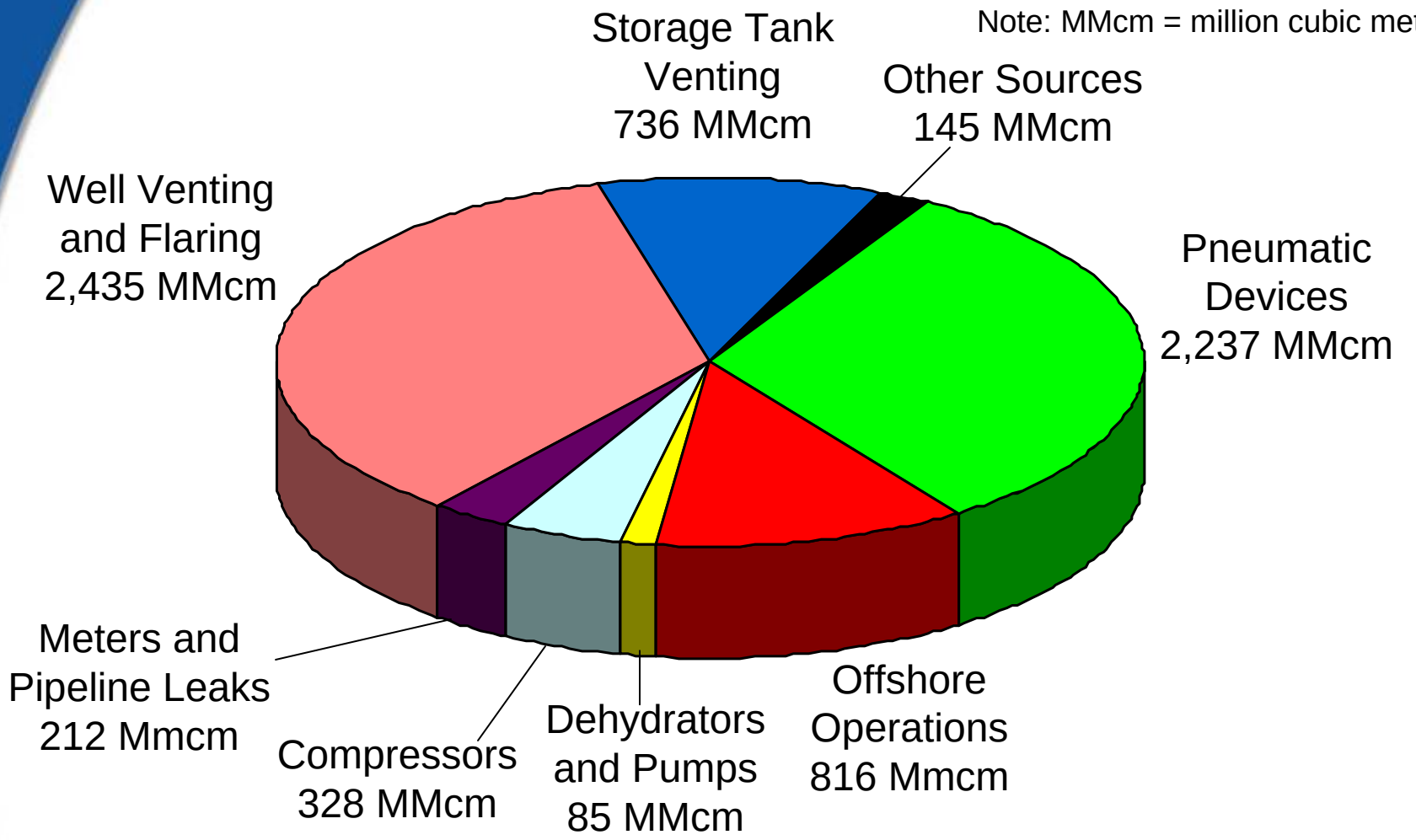
U.S. Production Sector Methane Emissions (2007)

Note: MMcm = million cubic meters



EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2007.* April, 2009. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html. Updated with revised emissions estimates for glycol dehydrators, well venting, pneumatic devices, and storage tanks.

Methane Losses – U.S. Production

- Over 550,000 producing gas wells in the U.S.
- Fugitive emissions from gas production facilities are estimated to be 4,700 million cubic meters per year
  - Estimated 10 thousand cubic meter emissions (Mcm) per well-year
  - Worth TMT 8,500 / well-year
- *See "Overview of Management Practices for Leak Detection, Quantification and Economic Repair for Compressors" presentation*

Source: Newfield

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Methane Losses – Natural Gas Well Liquid Unloading

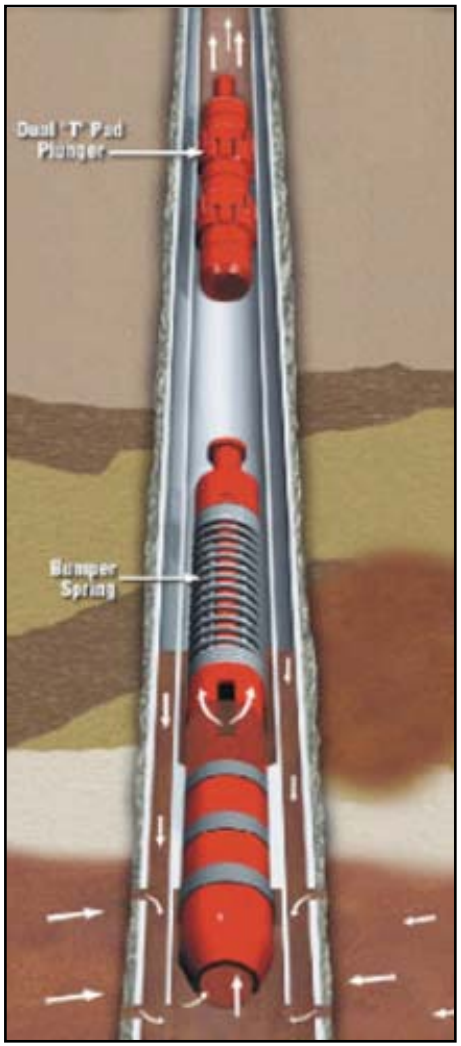
- Blowdowns to unload fluids can vent 2 to 45 thousand cubic meters per year to the atmosphere per well[1]
- Accumulation of liquid hydrocarbons or water in the well tubing reduces, and can halt, production
- Operators blowdown wells to atmosphere to expel liquids

Source: BP

[1] Mobil. *Pig Piney case study* (1997)

Plunger Lift Liquid Unloading

- Conventional plunger lift systems use well shut-in pressure buildups to efficiently lift columns of fluid out of well without venting
- U.S. gas wells have 175,000 plunger lifts
- Emission reductions using plunger lifts are 4,600 MMcm/year*
- Gas production is estimated to be as much as 10 percent higher with plunger lifts



Source: Weatherford

*Assumes 40% of plunger lift systems equipped with "smart" automation, 50% reduction from plunger lift and 75% reduction from plunger lift with "smart" automation

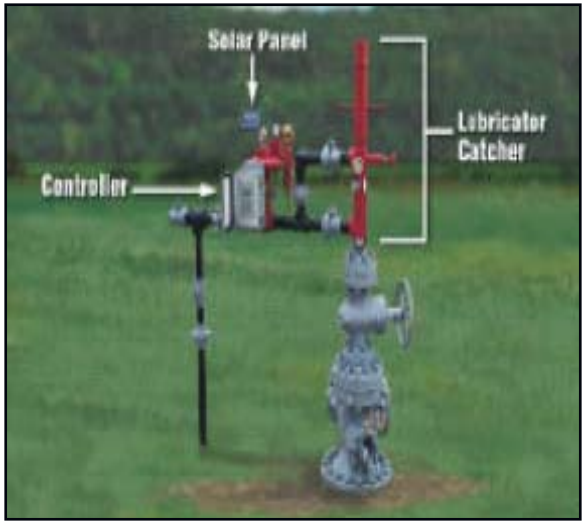
Conventional Plunger Lifts Have Significant Drawbacks

- Results in manual venting to atmosphere when plunger lift is overloaded
- Fixed timer cycles may not match reservoir performance
  - Cycle too frequently (high plunger velocity)
    - Plunger not fully loaded
  - Cycle too late (low plunger velocity)
    - Plunger over-loaded, stalls
    - Shut-in pressure can't lift plunger and fluid to top
    - May have to vent to atmosphere to lift plunger

Smart Automation Well Venting

- Automation can enhance the performance of plunger lifts by monitoring wellhead parameters such as:
  - Tubing and casing pressure
  - Flow rate
  - Plunger travel time
- Using this information, the system is able to optimize plunger operations
  - To minimize well venting to atmosphere
  - Recover more gas
  - Further reduce methane emissions

Automated Controllers



Source: Weatherford

- Low-voltage; solar recharged battery power
- Monitor well parameters
- Adjust plunger cycling

- Remote well management
  - Continuous data logging
  - Remote data transmission
  - Receive remote instructions
  - Monitor other equipment

Source: Weatherford

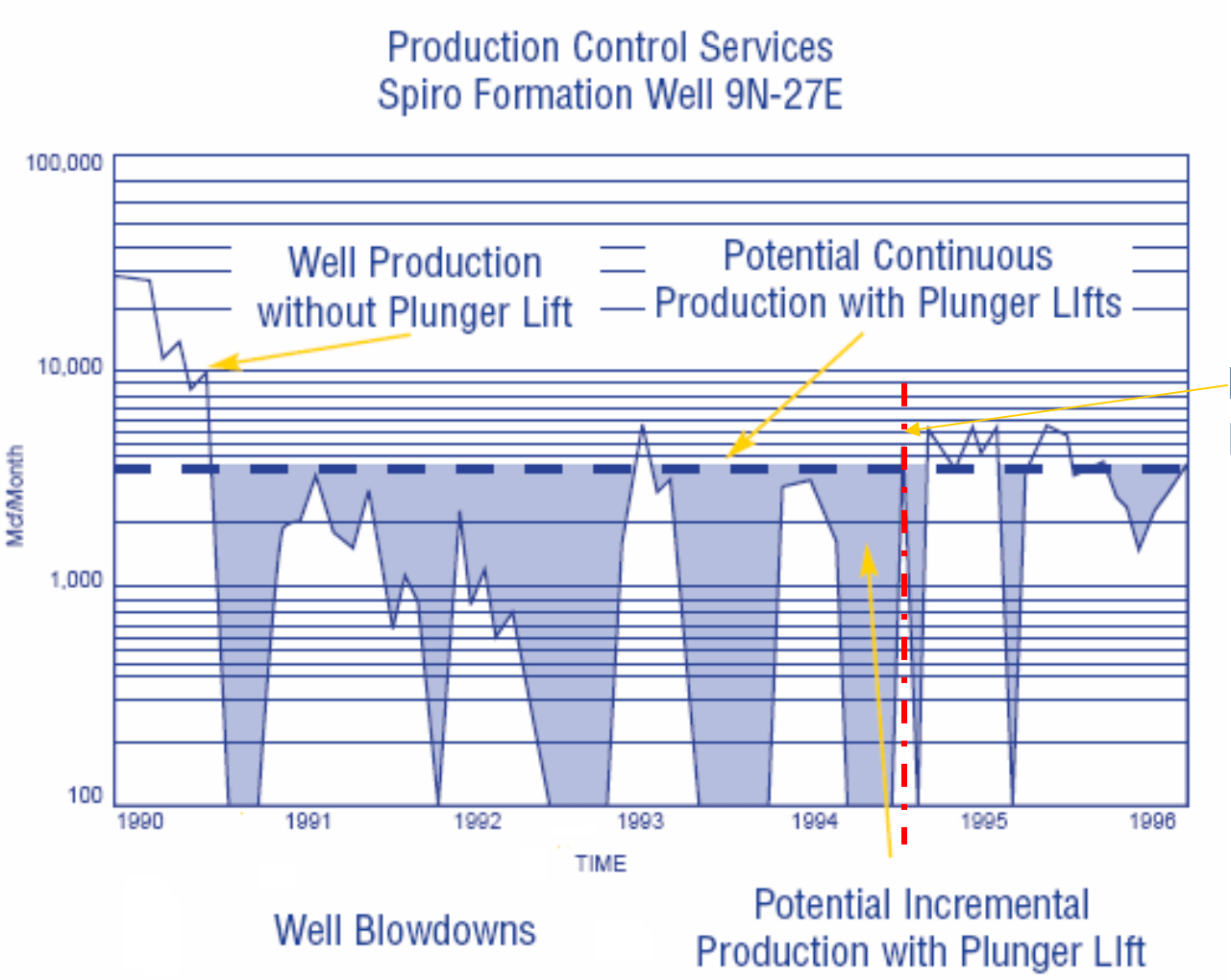
Methane Savings

- Methane emissions savings a secondary benefit
  - Optimized plunger cycling to remove liquids increases well production by 10 to 20%[1]
  - Additional 10%[1] production increase from avoided venting
- 12 thousand cubic meters per year of methane emissions savings for average U.S. well requiring unloading

Source: BP

1 - Reported by Weatherford

Increased Production is the Main Benefit of Plunger Lifts



Other Benefits

- Reduced manpower cost per well
- Continuously optimized production conditions
- Remotely identify potential unsafe operating conditions
- Monitor and log other well site equipment
  - Glycol dehydrator
  - Compressor
  - Stock tank
  - Vapor recovery unit

Is Recovery Profitable?

- Smart automation controller installed cost: ~TMT 30,000
  - Conventional plunger lift timer: ~TMT 15,000
- Personnel savings: double productivity
- Production increases: 10% to 20% increased production

- (Mcm/year) x (10% increased production) x (gas price)
  + (Mcm/year) x (1% emissions savings) x (gas price)
  + (personnel hours/year) x (0.5) x (labor rate)

  = TMT savings per year

Economic Analysis

- Non-discounted savings for an average well =

(1,400 Mcm/year) x (10% increased production) x (TMT 855/Mcm)
+ (1,400 Mcm/year) x (1% emissions savings) x (TMT 855/Mcm)
+ (500 personnel hours/year) x (0.5) x (TMT 45.5/hr)
- (TMT 30,000) cost

TMT 113,000 savings in first year

3 month simple payback

Industry Experience: British Petroleum (BP)

- BP's first automation project designed and funded in 2000
- Pilot installations and testing in 2000
  - Installed plunger lifts with automated control systems on ~2,200 wells
  - ~TMT 42,750 per well remote terminal unit (RTU) installment cost
  - TMT 142,500 – TMT 2,137,500 host system installment cost
- Achieved 50% reduction in venting from 2000 to 2004
- Achieved 90% reduction by 2007

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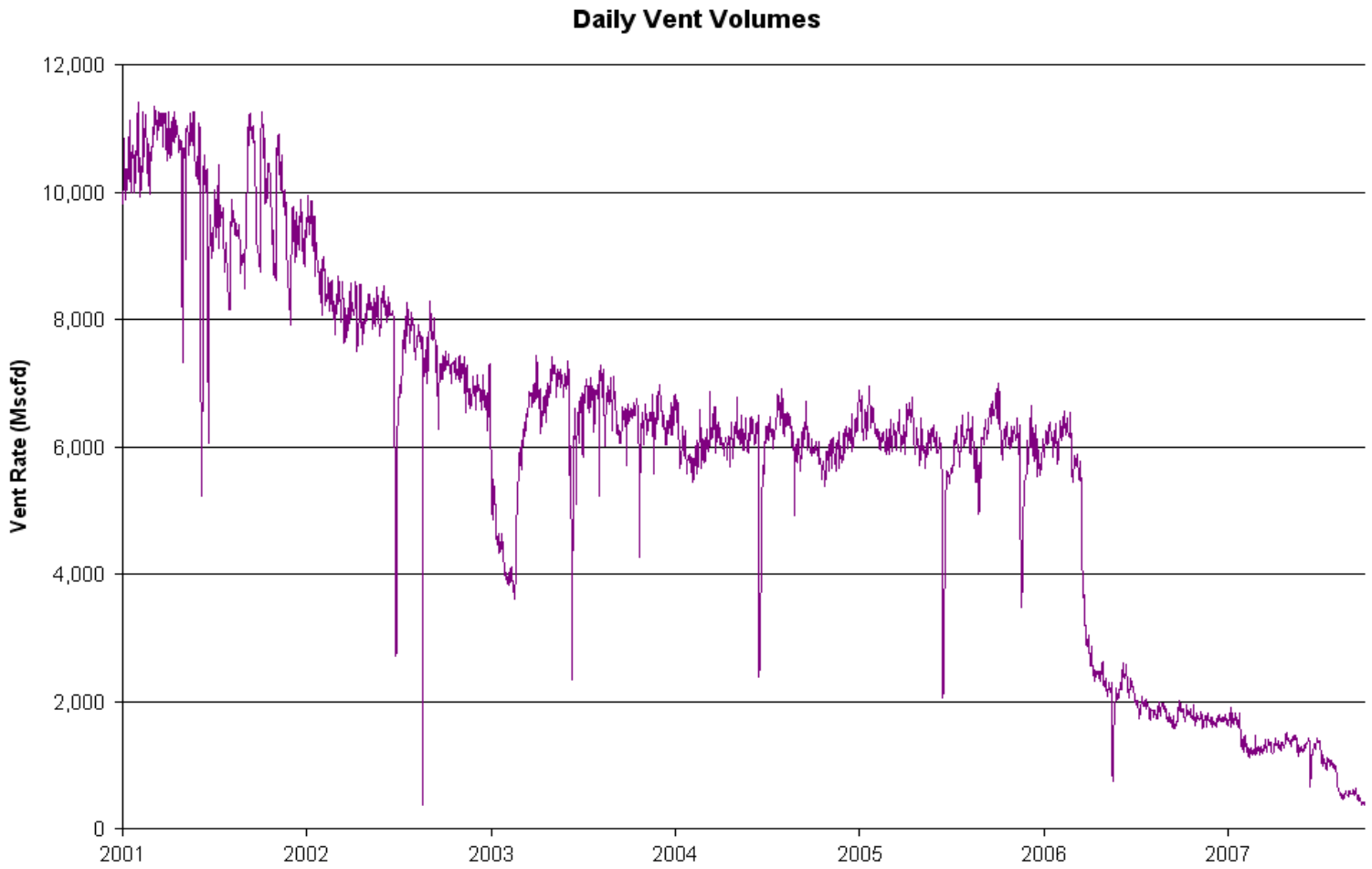
BP Well Venting Reduction Using Plunger Lifts and Smart Automation



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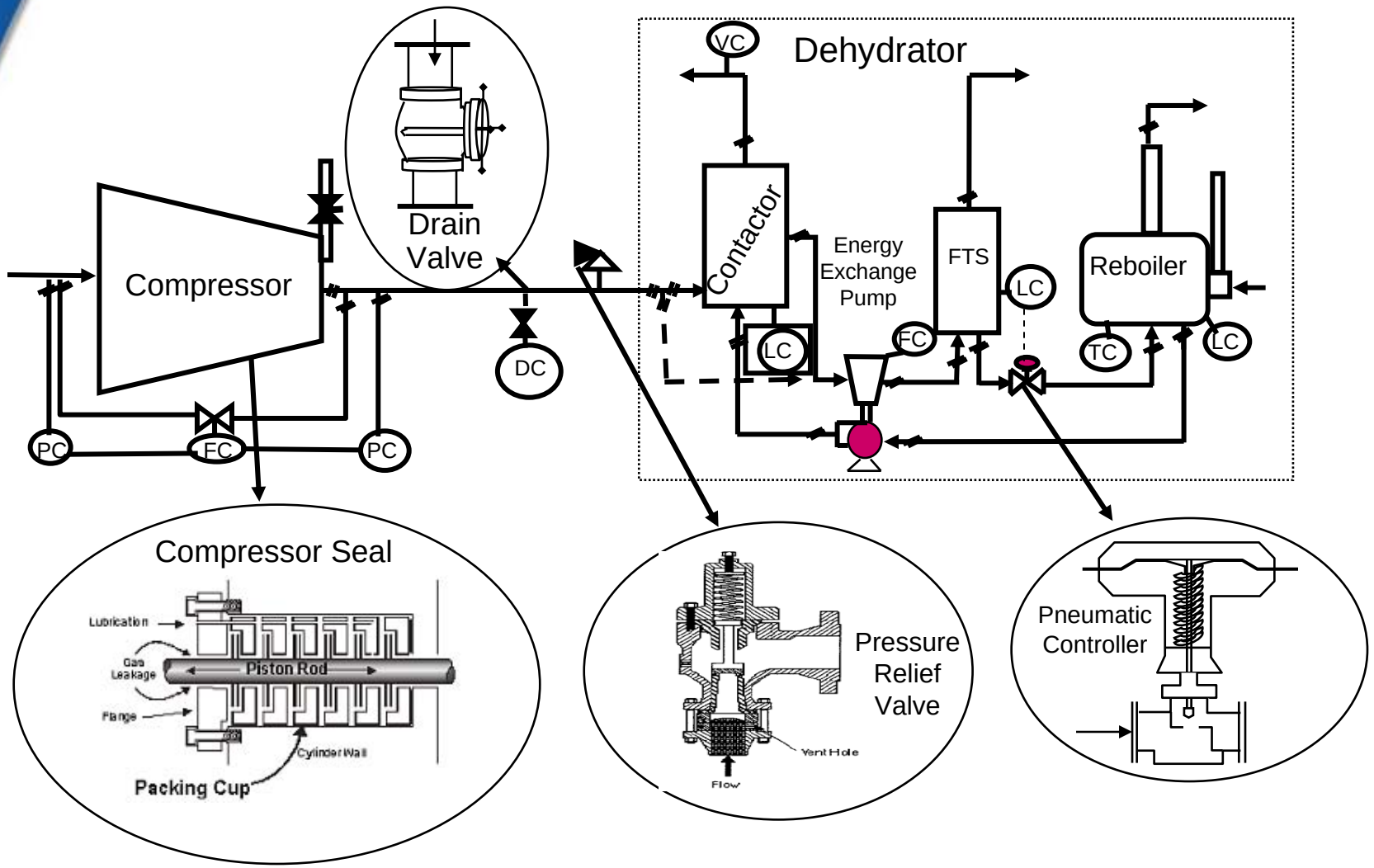
Source: BP

Sources of Methane Emissions in Underground Storage



Methane Losses – U.S Underground Storage

- Fugitive emissions from underground storage operations are estimated to be 400 million cubic meters per year
  - Similar in nature to fugitives in production sector
  - Estimated 2 thousand cubic meters (Mcm) of emissions per underground storage well
  - Estimated 220 Mcm of fugitive emissions per underground storage station; a value of TMT190,000 per station
- Solution to wellhead fugitives is leak inspection, quantification, and economic repair
  - *See "Overview of Management Practices for Leak Detection, Quantification and Economic Repair for Compressors" presentation*

Overview of Technologies and Practices

- 54 technologies and practices that apply to storage
  - 26 focused on operating practices
  - 28 focused on technologies
- Relevant storage technologies and practices:

Operating practices

- Begin leak detection, quantification and repair (*See "Overview of Management Practices for Leak Detection, Quantification and Economic Repair for Compressors" presentation*)
- Economic replacement of rod packing (*see "Methane Emissions Reduction Opportunities at Natural Gas Compressor Stations" presentation*)
- Rerouting glycol skimmer gas
- Taking compressors off-line

Technologies

- Convert gas-driven pneumatic devices to instrument air
- Install flash tank separators in glycol dehydrators
- Use of composite wrap repair (*see "Reducing Methane Emissions from Transmission Pipelines" presentation*)
- Replace wet seals with dry seals (*see "Methane Emissions Reduction Opportunities at Natural Gas Compressor Stations" presentation*)
- Automated air/fuel ratio controllers

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Contact Information 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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