Projects that Achieve Large Methane Emissions Reductions in Oil and Gas Operations

Oil and Gas Methane Emissions Reduction Workshop

Tomsk, Russia

14-16 September 2005

Methane to Markets

Agenda

- Why reduce methane emissions?
- Vapor recovery units
- Low-bleed pneumatic devices
- Directed inspection and maintenance
- Conclusions

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Why Reduce Methane Emissions?

- New technologies and practices to reduce methane emissions also increase profits
  - **sell carbon credits**
  - **sell natural gas**
  - **use natural gas for on-site fuel**
  - **reduce emissions**

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Storage Tanks: What is the Problem?

- Storage tanks are a major emissions source of:
  - **methane**
  - **ethane, propane, butane**
  - **benzene, toluene, and other pollutants**
- Flashing losses - occur when crude is transferred from a gas-oil separator at higher pressure to an atmospheric pressure storage tank
- Working losses - occur when liquid levels change and when liquid in tank is agitated
- Standing losses - occur with daily temperature and barometric pressure changes

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Reduce Emissions Using Vapor Recovery Units

- Vapor recovery units draw gas out of the tank and compress it to usable pressure
- Recovered vapors are more valuable than natural gas and have multiple uses
  - **re-inject into sales pipeline**
  - **use as on-site fuel**
  - **send to processing plants for recovering natural gas liquids**

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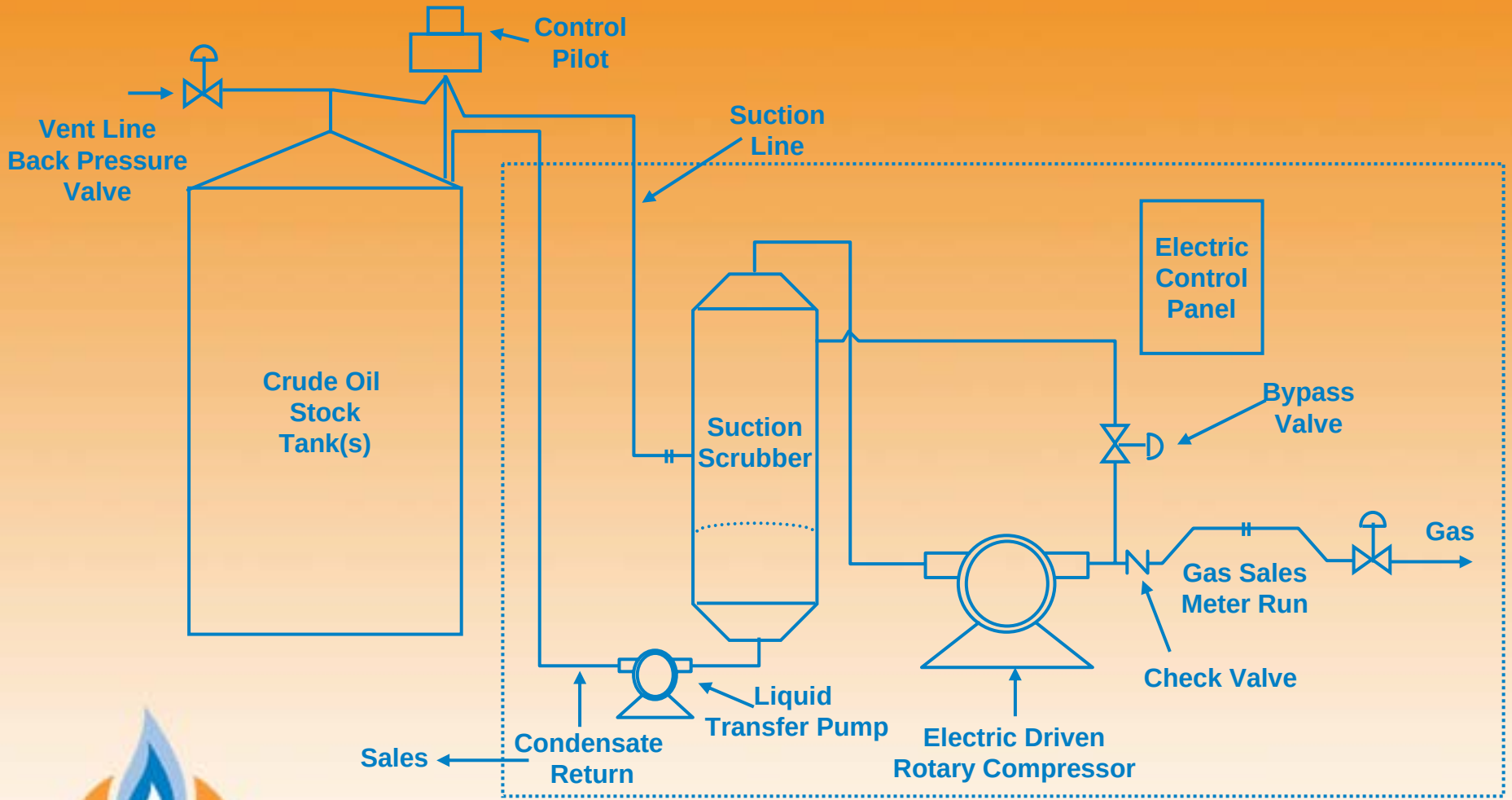
Standard Vapor Recovery Unit



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Source: Evans & Nelson (1968)

Vapor Recovery Unit: Economic Benefits

COSTS AND BENEFITS OF INSTALLING A VAPOR RECOVERY UNIT (VRU) ON PETROLEUM LIQUID STORAGE TANKS	
Capital Cost:	$15 for every cubic meter per day of capacity
Annual Operating Cost:	$3 for every cubic meter per day of capacity
Project Benefits:	Recovered vapors can be used for: • Carbon credits • Fuel gas • Sale • Natural gas liquids recovery
Annual Methane Savings:	140 to 2,700 thousand cubic meters
Example Economics for a 1.4 thousand cubic meter per day VRU	
Payback Period:	19 months - recovered vapor is valued at $0.11 per cubic meter
Carbon Credits:	3,500 Tonnes CO_2 equivalent
Breakeven carbon credit value*	$4.28 per Tonne CO_2 equivalent

* Assuming zero value for gas sales and 10% discount factor

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Pneumatic Devices: What is the Problem?

- During normal operations, pneumatic devices vent natural gas to atmosphere
- High-bleed devices vent an average of 11m^3 of natural gas per hour
  - **94,000 m^3/year**
- Actual bleed rate depends on device's design and purpose

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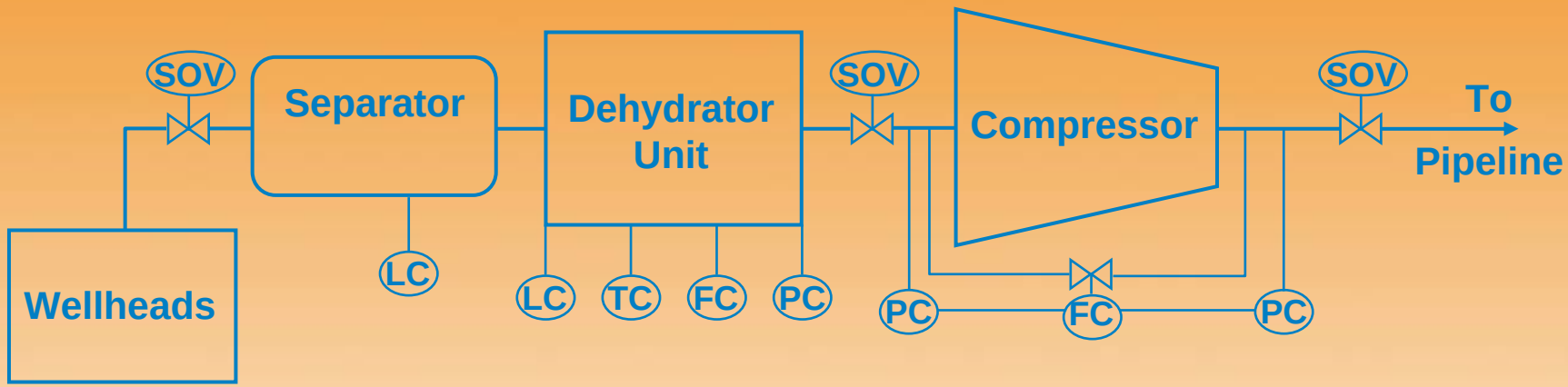
Location of Pneumatic Devices at Production Sites



SOV = Shut-off Valve (Unit Isolation)
LC = Level Control (Separator, Contactor, TEG Regenerator)
TC = Temperature Control (Regenerator Fuel Gas)
FC = Flow Control (TEG Circulation, Compressor Bypass)
PC = Pressure Control (FTS Pressure, Compressor Suction/Discharge)

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Reduce Emissions Using Low-Bleed Pneumatic Devices

- Replace high-bleed devices with low-bleed devices
  - **low-bleed devices perform the same function and vent less methane**
  - **replace at end of high-bleed device's economic life**
  - **typical costs range from $80 to $3,500 per device**
  - **up to 80% of all high-bleed devices can be replaced or retrofitted to low-bleed**

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Pneumatic Devices: Economic Benefits

COSTS AND BENEFITS OF REPLACING A HIGH-BLEED PNEUMATIC DEVICE WITH A LOW-BLEED PNEUMATIC DEVICE	
Capital Cost:	$80 to $3,500 – depends on application
Annual Operating Cost:	Minimal
Project Benefits:	Reduced methane emissions can be used for: • Carbon credits • Sale
Annual Methane Savings:	1 to 85 thousand cubic meters per year
Example Economics for installing a low-bleed liquid level controller	
Payback Period:	9 months - recovered vapor is valued at $0.11 per cubic meter
Carbon Credits:	67 Tonnes CO_2 equivalent
Breakeven carbon credit value*	$1.10 per Tonne CO_2 equivalent

* Assuming zero value for gas sales and 10% discount factor

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Methane Leaks: What is the Problem?

- Leaking valves, connectors, compressor seals and open-ended lines are major sources of methane emissions
- Methane leaks are *invisible*, *go unnoticed* and are *often unregulated*

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Methane Leaks: What is the Problem?

- Methane Emissions from Leaking Components

Component Type	% of Total Methane Emissions	% Leaks	Estimated Average Methane Emissions per Leaking Component (m3/year)
Valves (Block & Control)	26.0%	7.4%	1,869
Connectors	24.4%	1.2%	2,266
Open-Ended Lines	11.1%	8.1%	5,268
Pressure Relief Valves	3.5%	2.9%	23,902

Source: Clearstone Engineering, 2002, Identification and Evaluation of Opportunities to Reduce Methane Losses at Four Gas Processing Plants. Report of results from field study of 4 gas processing plants to evaluate opportunities to economically reduce methane emissions.

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Reduce Emissions with Directed Inspection and Maintenance

- Directed Inspection and Maintenance (DI&M)
  - **find and fix large leaks**
  - **periodically conduct follow-up surveys only on components likely to leak**

Toxic Vapor Analyzer

Optical Leak Imaging

- Screening - finding leaks
  - **soap bubble screening**
  - **electronic screening (sniffer)**
  - **toxic vapor analyzer (TVA)**
  - **organic vapor analyzer (OVA)**
  - **ultrasound leak detection**
  - **acoustic leak detection**
  - **optical leak imaging**

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Reduce Emissions with Directed Inspection and Maintenance

- Measure the leaks detected
  - **high volume sampler**
  - **toxic vapor analyzer (correlation factors)**
  - **rotameters**

Leak Measurement Using a High Volume Sampler

- United States company experience
  - **a tube fitting leaked 120,000 m^3/year. A very quick repair requiring only five minutes reduced the leak rate to 1,000 m^3/year. The gas saved was worth $12,000.**

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Directed Inspection and Maintenance: Economic Benefits

COSTS AND BENEFITS OF BEGINNING DIRECTED INSPECTION AND MAINTENANCE (DI&M) AT DISTRIBUTION GATE STATIONS AND SURFACE FACILITIES	
Capital Cost:	$1 per component to lease equipment
Annual Operating Cost:	$20 to $1,200 per distribution site
Project Benefits:	Reduced methane emissions can be used for: • Carbon credits • Sale
Annual Methane Savings:	17 thousand cubic meters per site
Example Economics for conducting DI&M at three distribution sites	
Payback Period:	7 months - recovered vapor is valued at $0.11 per cubic meter
Carbon Credits:	130 Tonnes CO_2 equivalent
Breakeven carbon credit value*	$1.14 per Tonne CO_2 equivalent

* Assuming zero value for gas sales and 10% discount factor

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Conclusions

SUMMARY OF METHODS TO ACHIEVE THE MOST METHANE EMISSIONS REDUCTIONS			
Technology	**Volume of Gas Saved Annually**	**Benefits**	**Implementation Cost (United States)**
Vapor Recovery	140 to 2,700 thousand cubic meters	Reduced emissions can be sold as gas or as carbon credits	$15 for every cubic meter per day of capacity
Low Bleed Pneumatic Devices	1 to 85 thousand cubic meters per device		$80 to $3,500 per device
Leak Inspection*	17 thousand cubic meters per distribution site		$20 to $1,200 per distribution site

*distribution example shown. DI&M applicable in all industry sectors

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Conclusions

- Companies profit when setting goals to reduce methane emissions
- Projects can rely on the value of the recovered methane to support positive economics

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