Major Methane Emission Sources from Offshore Platforms and Floating Production, Storage and Offloading Vessels (FPSOs)

EPA Middle East Meeting
Washington, D.C.
2 October 2012

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Agenda

- Offshore Platform Overview
- Identifying Offshore Emission Sources
  - Centrifugal Compressors
  - Cold Vents
  - Glycol Dehydrators
  - Storage Tanks
  - Fugitives
- Identifying, Prioritizing, and Implementing Mitigation Technologies

Offshore Platforms and FPSOs

- As offshore oil and natural gas production increases worldwide, this sector will increasingly contribute to industry methane emissions
- Offshore production presents many unique challenges
  - Limited space for additional equipment
  - Limited local demand for captured gas
  - Distance to market and lack of infrastructure

Source: rigzone.com

Identifying Offshore Emission Sources

- In 2010, offshore production of oil and natural gas made up 9% of methane emissions from the U.S. Production Sector and 6% of total methane emissions
  - Accounted for 41% of total methane emissions in the petroleum sector
- Sources of methane emissions on an offshore production platform can vary depending on configuration, and include:
  - Centrifugal compressor wet seal oil degassing
  - Cold vents
  - Storage tank venting
  - Glycol dehydrators
  - Fugitives

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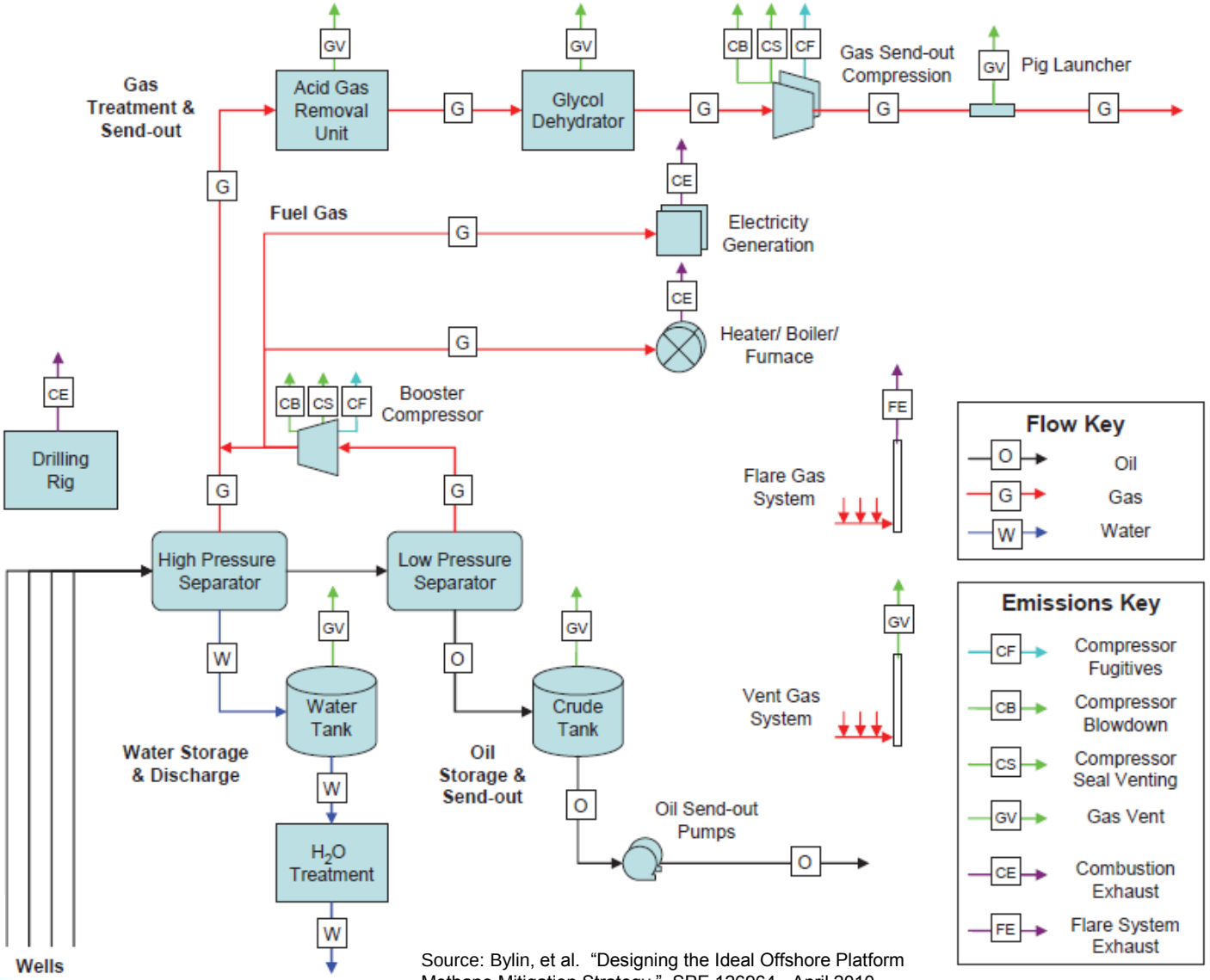
Offshore Platform Overview



Source: Bylin, et al. "Designing the Ideal Offshore Platform Methane Mitigation Strategy." SPE 126964. April 2010.

Centrifugal Compressor Emissions

- Most methane emissions from centrifugal compressor occur during from the degassing and recirculation of the seal oil
  - Vent rates can be upwards of 2.9 million m^3 methane per year
- According to a 2010 EPA study, centrifugal compressor wet seal oil degassing was the ***single largest source*** of emissions on offshore platforms
  - **Accounts for nearly 78% of total emissions**

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Cold Vent Emissions

- Cold vents are common vent stacks that handle routine and non-routine releases of natural gas
  - Compressor blowdowns
  - Process upsets
  - Emergency shutdowns
- Second largest source of emissions, based on 2010 EPA report
  - Account for nearly 9% of total methane emissions

Storage Tank Emissions

- Storage tanks have several sources of emissions:
  - **Flashing losses** occur when crude is transferred from containment at a high pressure to containment at a lower pressure
  - **Working losses** occur when crude levels change and when crude in the tank is agitated
  - **Standing losses** occur with daily and seasonal temperature and pressure changes
- All of these losses release methane and other light hydrocarbons, which are often simply vented to the atmosphere

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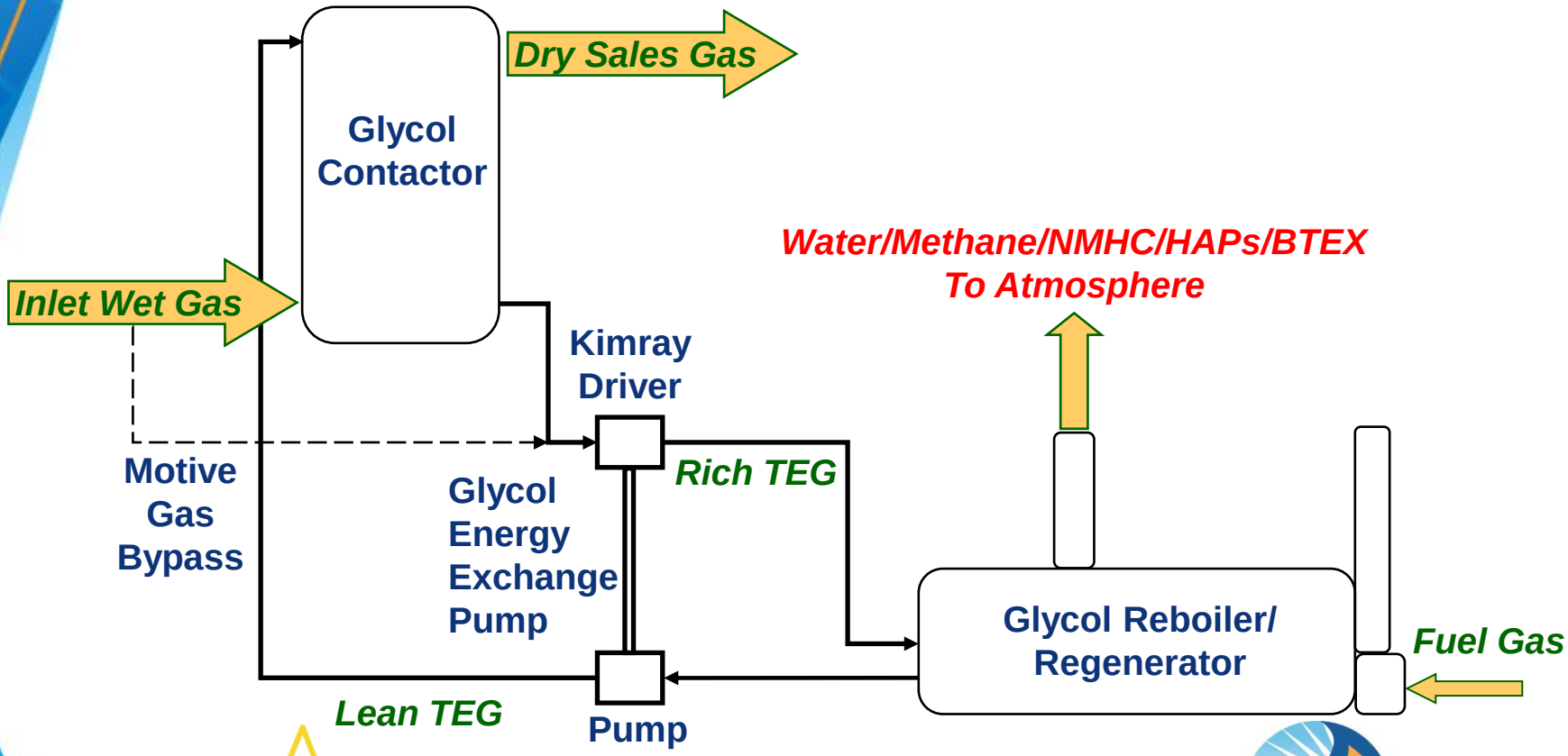
Dehydrator Emissions

- Glycol dehydrators are the most common equipment used to remove water from produced natural gas



Fugitive Emissions

- Fugitive emissions occur randomly from various components installed on an offshore platform
  - Valves
  - Flanges
  - Connectors
  - Open-ended lines
- Emissions are often impossible to detect without specialized equipment
- Collectively, fugitives account for 7% of offshore emissions

Identifying, Prioritizing, and Implementing Mitigation Technologies

- The offshore environment provides many unique challenges that can hinder emissions mitigation
  - Harsh and isolated environment
  - Higher overall costs
  - Fewer options for recovered methane
- Therefore, it is critical to identify and implement the most cost-effective technologies

Source: rigzone.com

Step 1. Determine Platform Emissions

- Determine methane emissions sources on the platform
- Decide upon methane emissions calculation methodology for sources on the platform
  - Direct measurement, engineering calculations, or application of emissions factors
- Collect activity data and supporting measurement necessary for the defined calculation methodologies
  - Gas composition analyses will aid in determining methane emissions as the methane content of associated natural gas can change
- Calculate methane emissions for each source using the collected activity data and following the chosen calculation methodologies

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Step 2. Identifying Mitigation Technologies and Practices

Emission Source	Technology or Practice
Centrifugal compressor wet seal degassing	• Replace centrifugal compressor wet seals with dry seals or capture seal oil vent gas
Cold vents	• Route individual vented emissions sources to vapor recovery unit • Route routine compressor blowdowns to fuel gas system
Storage tank venting	• Install vapor recovery unit • Scrubber dump valve testing and repair
Glycol dehydrators	• Route non-condensable gas from condenser vent to vapor recovery unit • Optimize glycol circulation rate
Fugitives	• Directed inspection and maintenance program

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Step 3. Determine Costs

- The Natural Gas STAR Program technical documents report ranges of costs for emissions mitigation options
- Costs for applying the same technologies/practices offshore can be significantly higher
  - Capital costs are higher as equipment may need to be more robust or reduced in size
  - Installation costs can be much higher due to the transport and lifting of equipment
    - A derrick barge for lifting heavy equipment of up to 45,000 kg (100,000 lb) can cost up to U.S.$70,0000 per day
  - O&M costs are inflated due to an adverse operating environment
    - In the Gulf of Mexico, labor rates are generally 30% higher than those of onshore operators

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Step 4. Determine Savings

- To estimate emissions reductions, each mitigation option must be examined individually.
  - Some options, such as installing instrument air to power pneumatic devices, can eliminate 100% of methane emissions
  - Other options, such as DI&M, have been reported to reduce between 60–80% of total fugitive methane emissions
- Installing meters or “before and after” direct measurement can determine gas savings
  - Actual savings from each installed mitigation option should be recorded to track effectiveness of the project.

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Recommended Technologies (Arabic)

epa.gov/gasstar/tools/arabic/index.html