

Improving Flash Gas Emission Calculations from Storage Tanks

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The logo features a large yellow five-pointed star outline. Inside the star, there is a blue flame icon with a yellow base. The text "Natural Gas" is written in a blue serif font, and "EPA POLLUTION PREVENTER" is written in a smaller blue sans-serif font below it.

Natural Gas
EPA POLLUTION PREVENTER

Significant Methane Emission Sources in Oil and Gas Production (Gg)



Activity	2005	2007	2008	2009	2010	2011
Oil Production Field Operations	1,366	1,396	1,407	1,432	1,443	1,475
Pneumatic Device Venting	398	398	416	419	416	428
Tank Venting	188	193	185	202	211	221
Combustion & Process Upsets	71	72	75	94	95	99
Wellhead Fugitives	19	20	24	23	22	24
Misc. Venting and Fugitives	690	714	706	694	700	702
Natural Gas Systems	7,572	8,018	7,782	7,178	6,838	6,893
Field Production	3,595	3,958	3,640	2,948	2,724	2,545
Processing	667	723	756	834	787	932
Transmission & Storage	1,879	1,942	1,964	2,021	1,980	2,087

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011 – Tables 3-37 & 3-44 (EPA 430-R-13-001, 04-12-2013)

Flash Gas Emissions from Oil and Gas Production Facilities



- **Flash gas is produced when pressure applied to produced liquids is lowered**
- **Flash gas may arise from both oil and water**
- **Normal methods for quantifying flash gas are:**
 - Vasquez-Beggs Equation (simple mathematics)
 - API E&P Tanks Program (iterative calculations)
 - Process simulation software (HYSIS, PROMAX, etc.)
 - Measurements
- **Specific data are required by each approach**
- **Assumptions may be made regarding certain data or operating conditions**
- **Accuracy of results depends on the input data available**

Challenges to Accurate Predictions

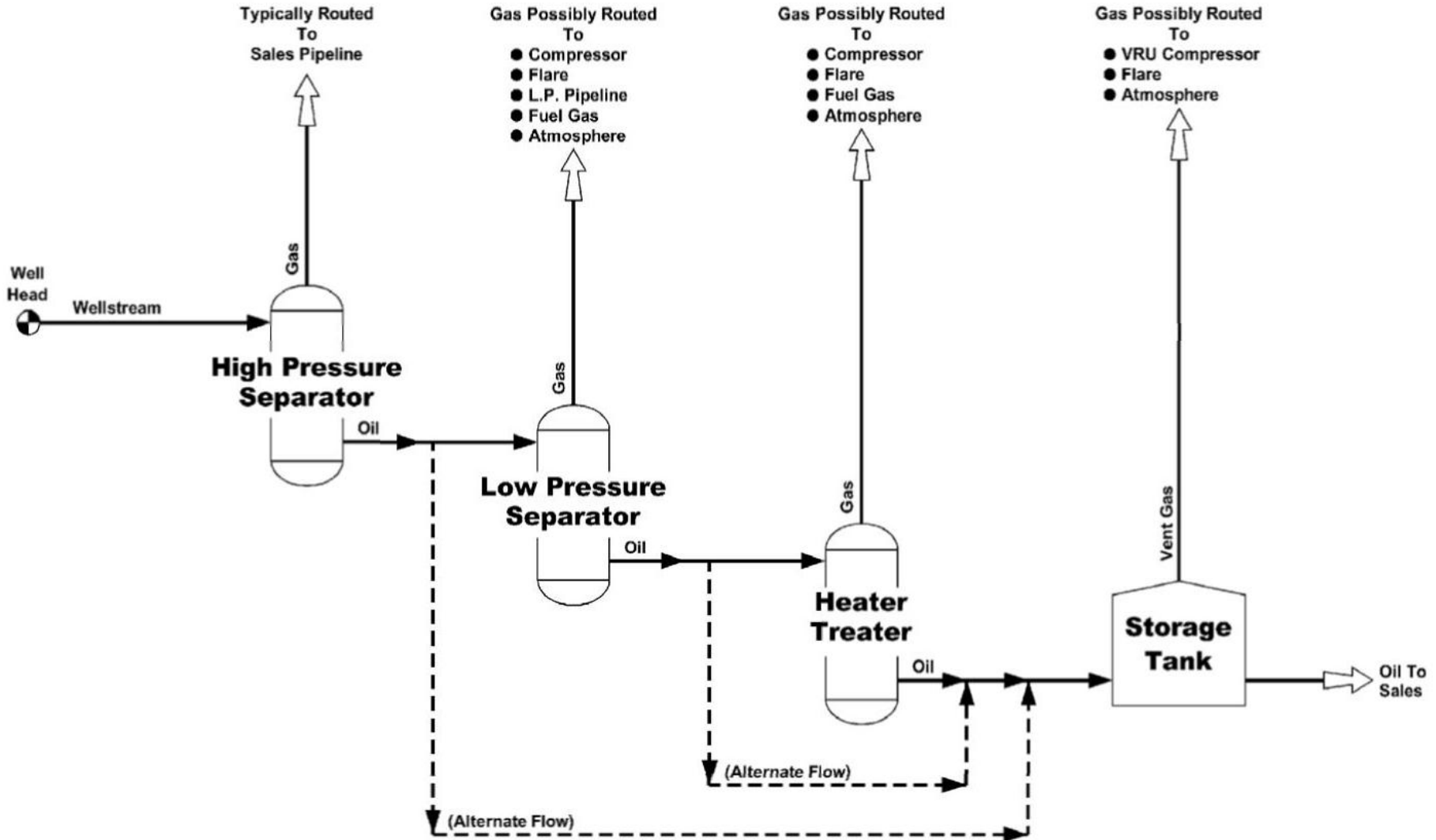
- **Data needs for each method are specific**
- **Sampling of several production phases may be necessary to obtain the required model inputs**
- **Laboratory speciation analysis followed by calculation of mixture parameters provides model inputs**
- **Collecting representative samples of multi-phase materials is a major concern**
- **Sampling may be simple compared to analysis**
- **Other sources of gas emissions may be vented to tanks**
 - Glycol dehydrator vents
 - Other process vents, including prior separator stages
 - Process upsets (stuck dump valves, maintenance venting, etc.)

Sampling Approach



- **Determine the composition data required**
 - What are the conditions at the final pressure drop?
 - Which gas streams are vented, flared or used as fuel?
 - What streams have significant potential for fugitive emissions?
 - Are multiple product streams combined prior to an emission point?
 - What quality assurance/control checks are needed for the data produced?
- **Identify other data necessary for performing the flash gas calculation method selected**
- **Use a sketch of the facility to identify the piping diagram (showing process fluid flows) and each sample location**

Flash Gas Emission Sources



Data Requirements for E&P Tanks

- **Physical Data**
 - Separator temperature (°F)
 - Separator pressure (psig)
 - Ambient temperature (°F)
 - Ambient pressure (psia)
 - Facility location (latitude/longitude or UTM coordinates)
 - Separator throughput (bbls/day)
- **Chemical Data**
 - Composition and GOR of high-pressure or low-pressure oil
 - Composition of high-pressure gas
 - Molecular weight and specific gravity for oil and gas samples
 - API gravity and Reid vapor pressure of oil samples
- **Other**
 - Operating Schedule (days/year)

E&P TANKS Set-up Options



The screenshot shows the "E&P TANK - Untitled.Ept" software window. The menu bar includes "File", "View", "Unit Conversion", "Run", and "Help". The toolbar contains icons for file operations and simulation. The main interface is titled "Project Setup" and has two tabs: "Configuration" (selected) and "Project Description".

Flowsheet Selection:

- Tank with Separator (with separator icon)
- Stable Oil Tank (with tank icon)

Model Selection for W&S Losses:

- AP-42 (uses methodologies documented in EPA AP-42)
- RVP Distillation Column

Known Separator Stream Information:

- 1. Low Pressure Oil
- 2. High Pressure Oil
- 3. Low Pressure Gas (with separator icon)
- Geographical Database

Control Efficiency:

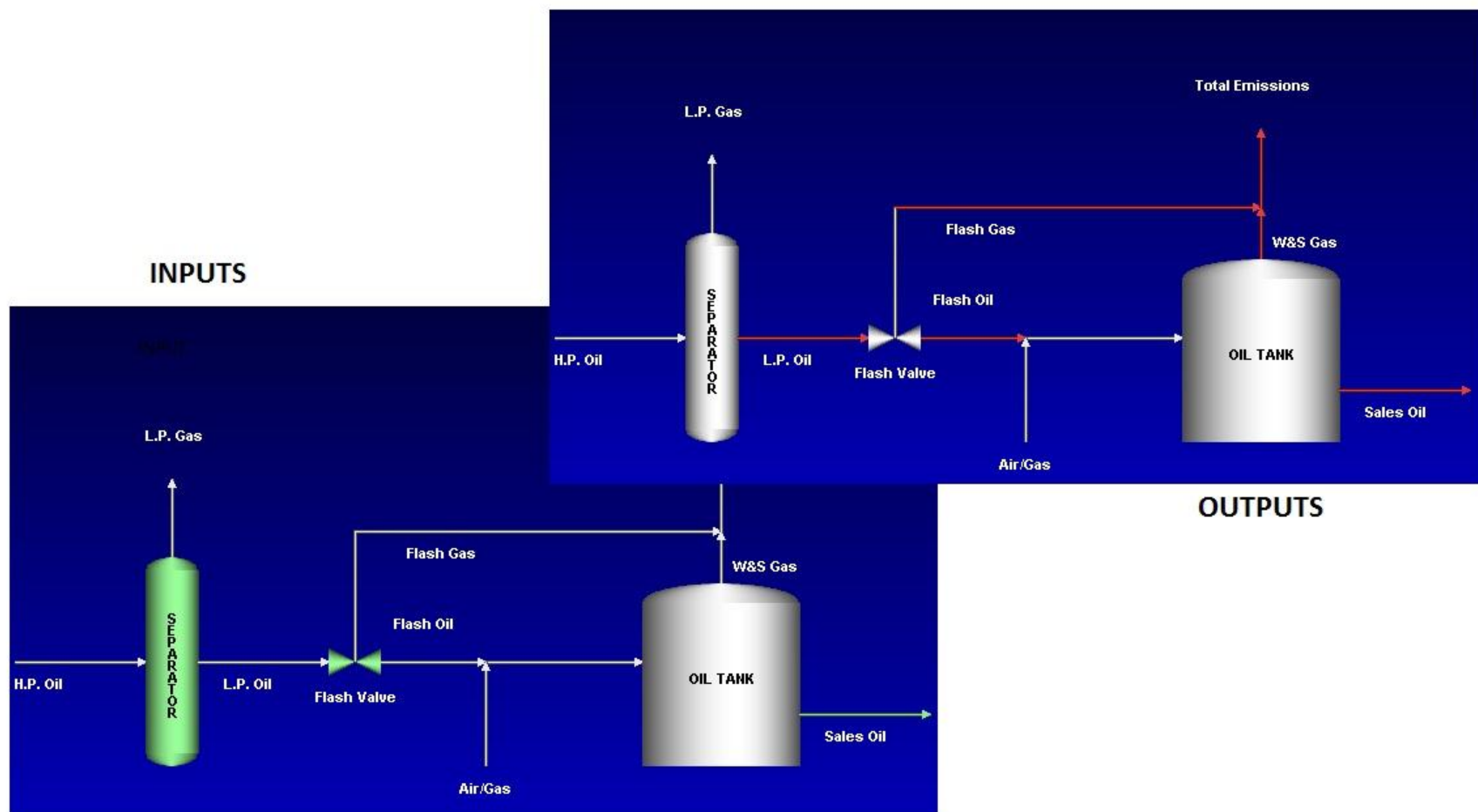
- Use Control Efficiency

Air Injection:

- Enter Air Composition for Air/Gas Injection (with air injection icon)

A sidebar on the left contains three icons: "Project Setup", "Data Input", and "Data Output".

Input & Output Screens



Data Inputs for High or Low Pressure Oil



Three overlapping 'Low Pressure Oil Input' dialog boxes are shown, illustrating different input configurations for separator conditions and compositions.

Dialog 1 (Left): Separator Conditions: Pressure = 23.0 [psig].

No.	Component	mol %
1	H2S	0.0508
2	O2	0.0000
3	CO2	0.2437
4	N2	0.0102
5	C1	0.9543
6	C2	0.6701
7	C3	2.1827
8	i-C4	1.1269
9	n-C4	4.6091
10	i-C5	3.1066

Total = 100.0000

Buttons: Normalize, OK

Dialog 2 (Middle): Separator Conditions: Pressure = 23.0 [psig].

No.	Component	mol %
10	i-C5	3.1066
11	n-C5	5.0558
12	C6	4.1726
13	C7	10.3655
14	C8	10.8426
15	C9	5.5127
16	C10+	45.9695
17	Benzene	0.5685
18	Toluene	0.2132
19	E-Benzene	0.0711

Total = 100.0000

Buttons: Normalize, OK

Dialog 3 (Right): Separator Conditions: Pressure = 23.0 [psig], Temperature = 85.0 [F].

No.	Component	mol %
13	C7	10.3655
14	C8	10.8426
15	C9	5.5127
16	C10+	45.9695
17	Benzene	0.5685
18	Toluene	0.2132
19	E-Benzene	0.0711
20	Xylenes	0.6802
21	n-C6	3.5939
22	224Trimethylp	0.0000

Total = 100.0000

Buttons: Normalize, OK, Cancel, Help

C10+ Characterization Table:

Item	Data
Mw	166.00
SG	0.8990

Data Inputs for Gas Phase



Low Pressure Gas Input

Separator Conditions
 Pressure: 23.0 [psig]

Compositions

No.	Component	mol %
1	H2S	0.0000
2	O2	0.0075
3	CO2	0.5145
4	N2	0.5329
5	C1	76.5098
6	C2	8.6730
7	C3	7.6347
8	i-C4	0.9855
9	n-C4	1.8224
10	i-C5	0.7969

Total = 100.0000

GOR: Ratio of Separator Gas and Separator Oil
 Data Type: Molar GOR Volumetric GOR

Buttons: Normalize, OK

Low Pressure Gas Input

Separator Conditions
 Pressure: 23.0 [psig] Temperature: 85.0 [F]

Compositions

No.	Component	mol %
10	i-C5	0.7969
11	n-C5	1.3635
12	C6	0.2318
13	C7+	0.6783
14	Benzene	0.0262
15	Toluene	0.0273
16	E-Benzene	0.0051
17	Xylenes	0.0108
18	n-C6	0.1798
19	2,2,4-Trimethylp	0.0000

Total = 100.0000

Molar Ratios in Sep. Oil

Component	Ratio
C7	1.0000
C8	1.0000
C9	1.0000
C10+	1.0000

C10+ Characterization


Item	Data
MW	166.00
SG	0.8990

GOR: Ratio of Separator Gas and Separator Oil
 Data Type: Molar GOR Volumetric GOR
 Molar GOR: 0.0500
 Enter Volumetric GOR

Buttons: Normalize, OK, Cancel, Help

Inputs for Physical Data

Flash Valve Input



The flash valve is shown for illustration purposes only to indicate pressure reductions through a flow line.
A calculation will be performed to flash the separator oil to the ambient condition


Ambient Pressure [psia]

Ambient Temperature [F]

1 atmosphere pressure equals to 14.7 psia.
If known, enter the ambient or tank inlet temperature. Otherwise, enter the upstream separator temperature.

OK Cancel Help

Sales Oil Input



Production Rate [bbl/day]

Days of Annual Operation [days/year]

API Gravity

Reid Vapor Pressure [psia]

OK Cancel Help

Laboratory Management Approach

- **Work with the laboratory on sampling and analysis before sampling**
- **Tell the laboratory exactly what data are expected to be in the lab report**
- **Ensure that liquid sample analyses include at least C₁ through C₉ and C₁₀s+, HAPs, He, H₂, N₂, O₂, and CO₂**
- **Obtain data for H₂S and total sulfur for each phase or sample**
- **Report mole % and weight % for each constituent and molecular weight of each gas or liquid mixture**

Continued on the next slide »

Laboratory Approach (continued)

- Calculate and report vapor pressure, specific gravity, API gravity, Reid vapor pressure, and GOR for liquid samples
- Calculate and report vapor density (or specific gravity), heat content (MMBtu/scf), and molecular weight of each gas
- Ensure that the requested analytical report covers data needed for other purposes (health risk impacts, GHG emission reports, etc.)
- Ensure that all field sampling data (separator temperatures and pressures, ambient temperature, and ambient pressure) are included in the lab report

Summary



- **Calculating and reporting flash gas emission rates from oil and gas facilities can and should be improved**
- **Flash gas data are not only important for monitoring process emissions and documenting CH₄ reductions, but also for numerous other required emission calculations**
- **Involving the analytical laboratory prior to sampling helps ensure completeness of data for process modeling inputs**
- **Using good sampling and analysis procedures is important for ensuring quality results**
- **Things at the facility are not always what they appear to be, so document any unusual situations observed during the sampling process**
- **Process upsets happen and do not produce representative samples for performing emission calculations**

Contact Information



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Questions?