Improving Flash Gas Emission Calculations from Storage Tanks

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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**

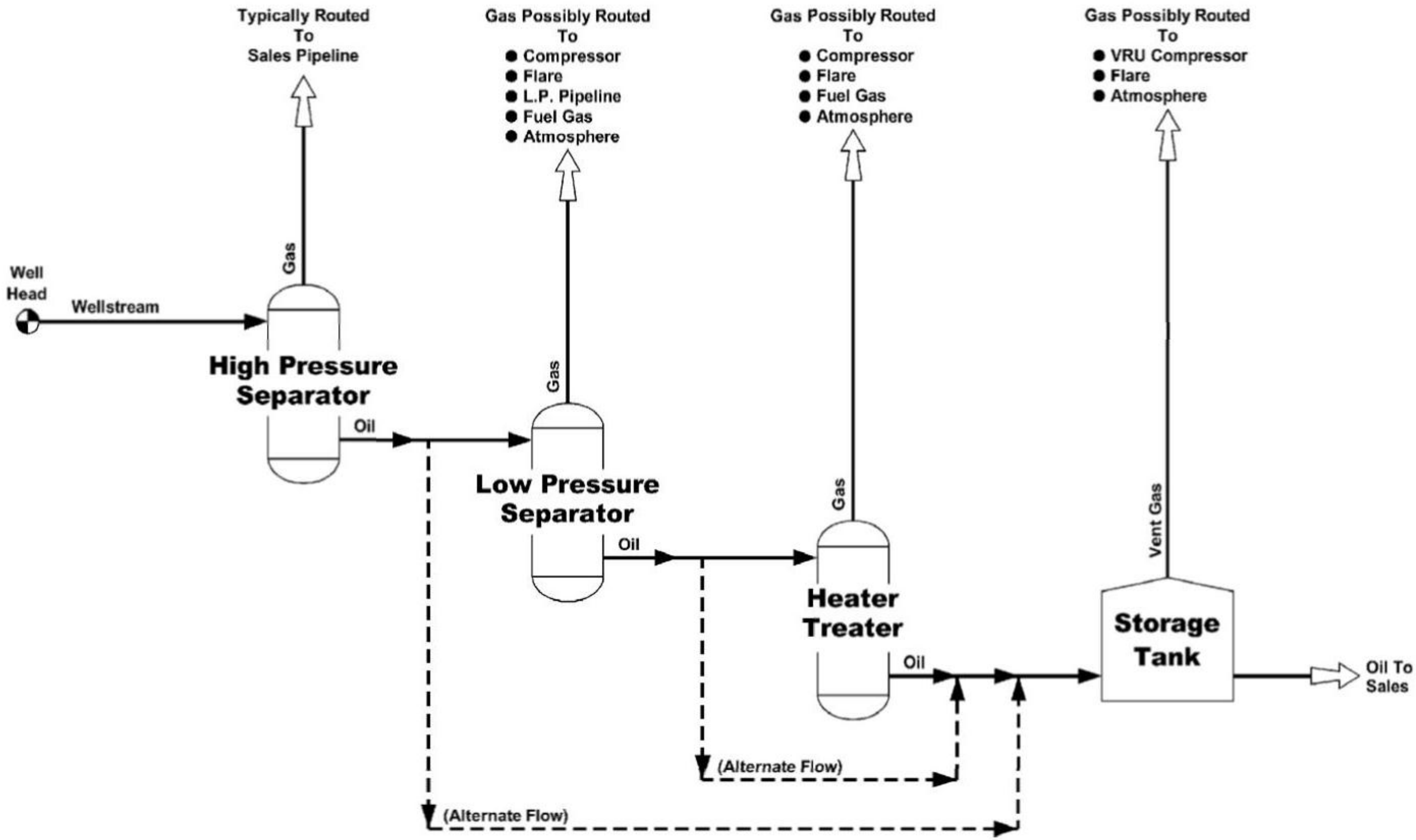
Challenges to Accurate Predictions

- **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**

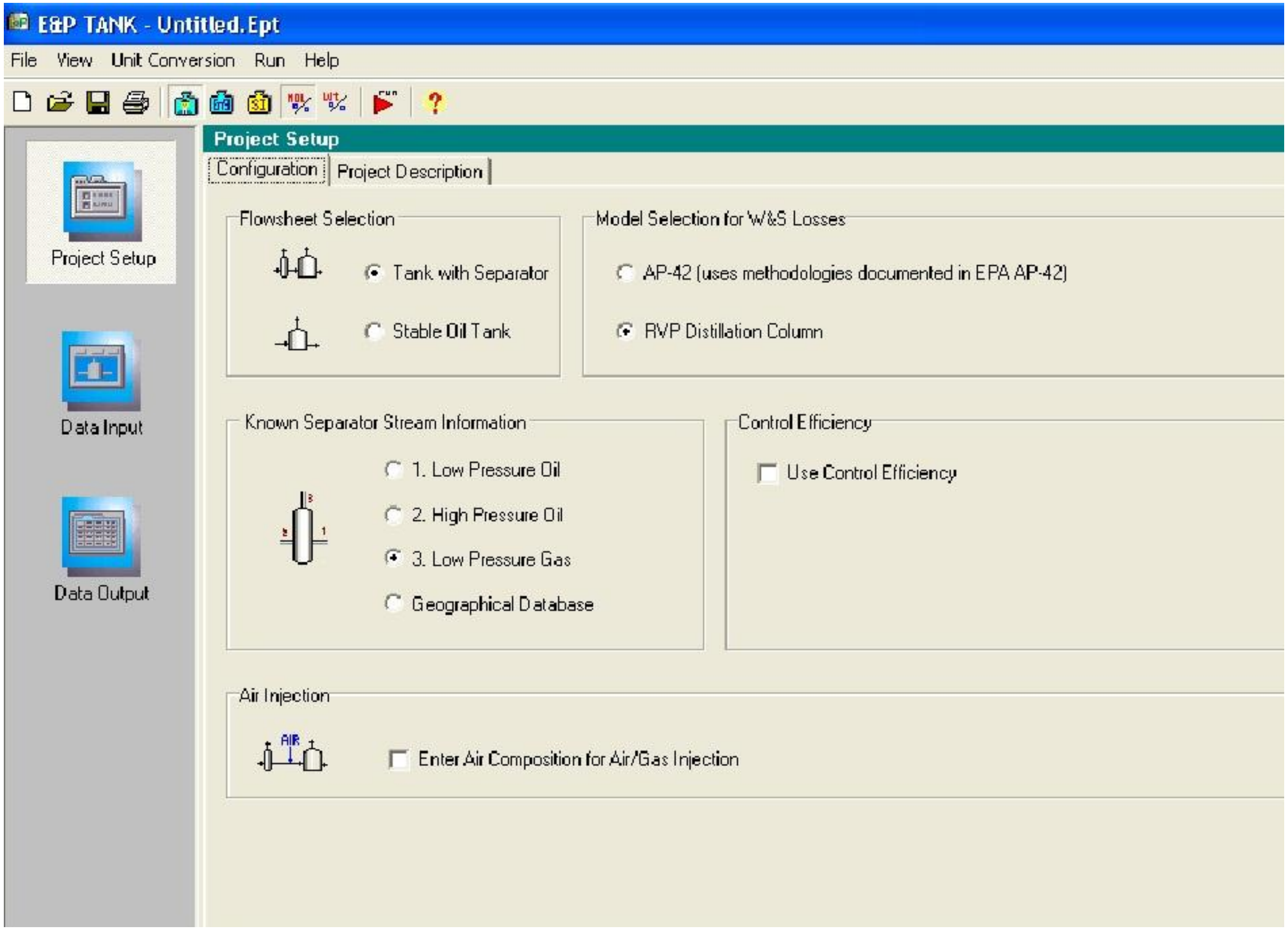
Flash Gas Emission Sources



Data Requirements for E&P Tanks

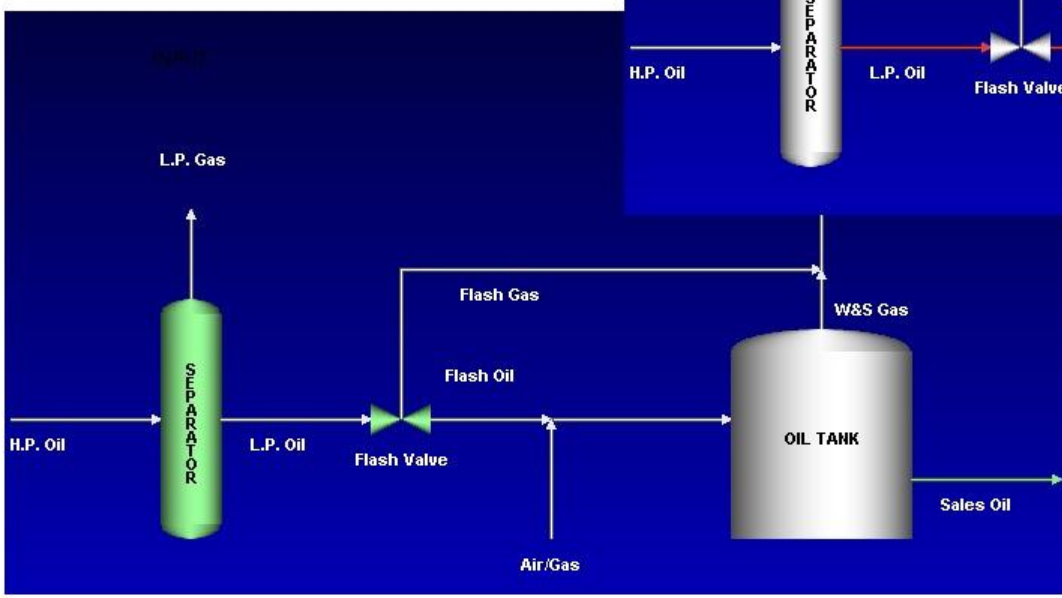
- **Physical Data**
  - Separator temperature (^oF)
  - Separator pressure (psig)
  - Ambient temperature (^oF)
  - Ambient pressure (psia)
  - Facility location (latitude/longitude or UTM coordinates)
  - Separator throughput (bbls/day)
- **Chemical Data**
  - Composition and GOR of high-pressure or 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)

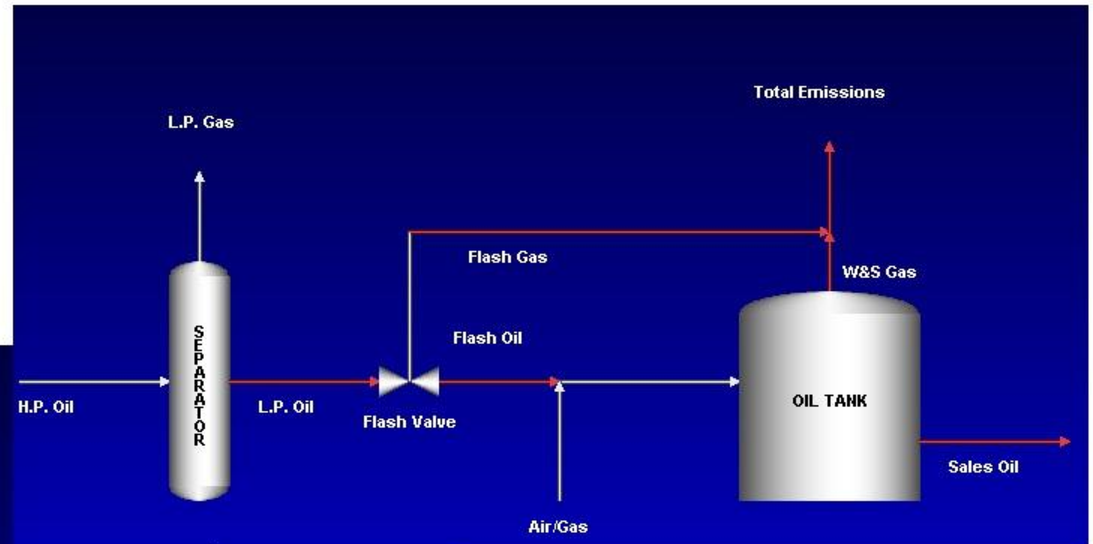
E&P TANKS Set-up Options



Input & Output Screens

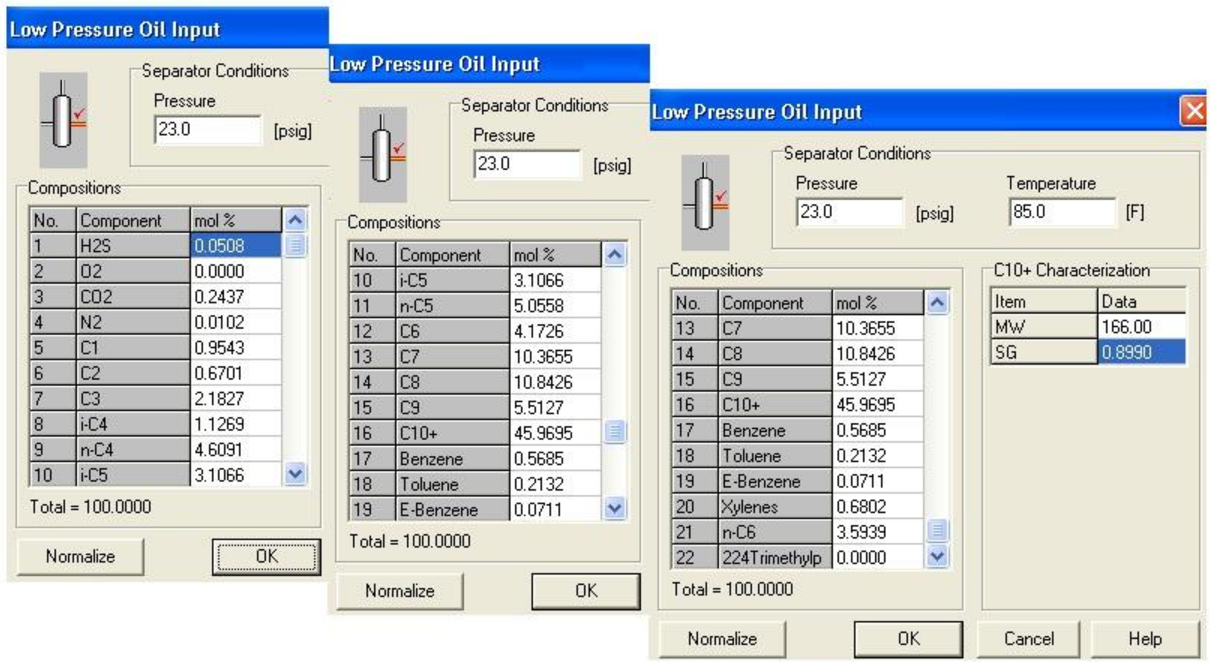
INPUTS



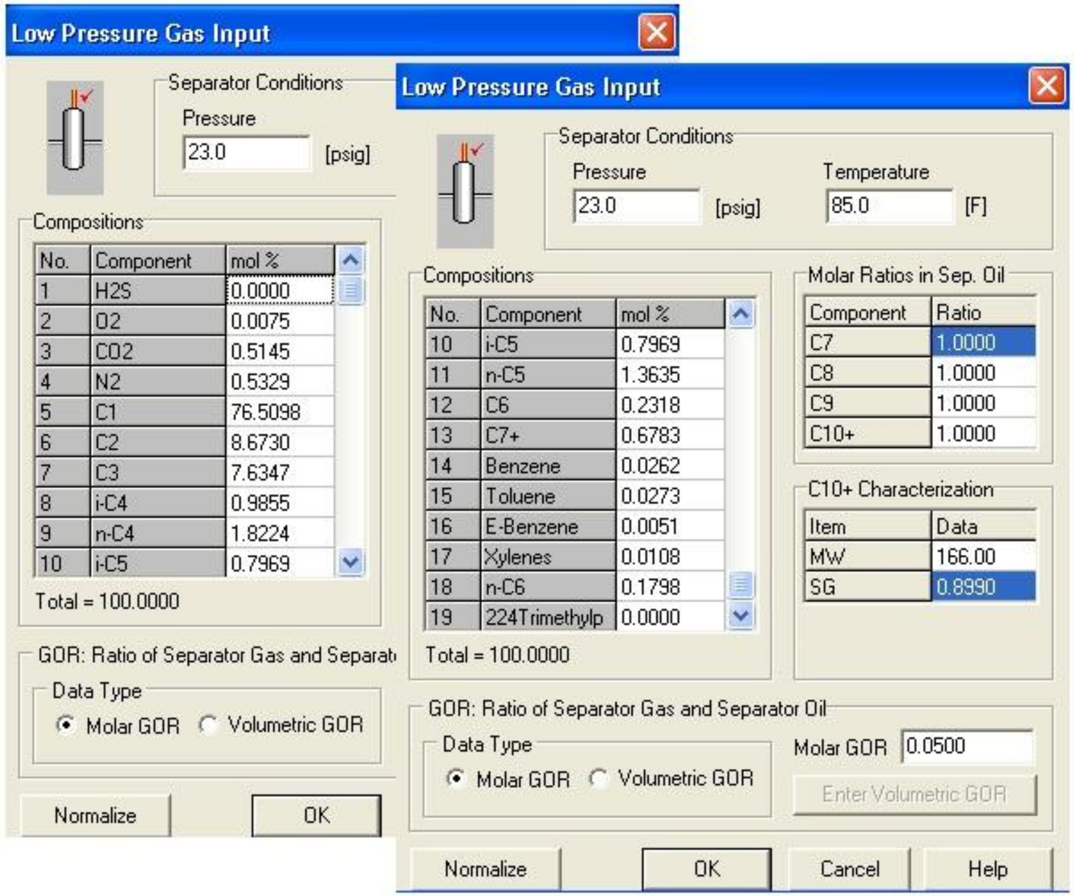


OUTPUTS

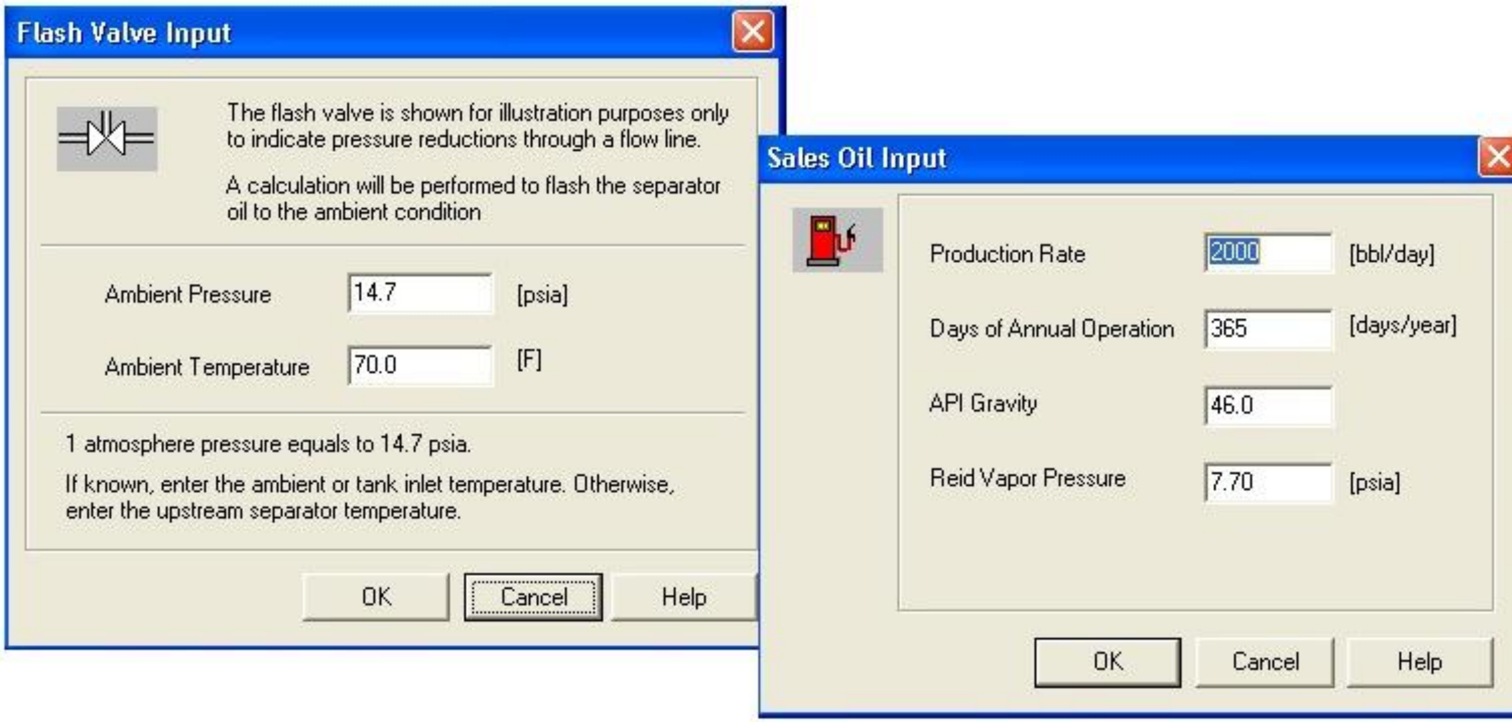
Data Inputs for High or Low Pressure Oil



Data Inputs for Gas Phase



Inputs for Physical Data



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 C_1 through C_9 and C_{10}s+, HAPs, He, H_2, N_2, O_2, and CO_2**
- **Obtain data for H_2S and total sulfur for each phase or sample**
- **Report mole % and weight % for each constituent and molecular weight of each gas or liquid mixture**

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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 CH_4 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

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Questions?