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Test Separator

vs



Emerging New Technology -
MultiPhase Flow Meter (MPFM)

“REDUCE THE FLANGES ... REDUCE THE EMISSIONS”

Regulation Consideration: Phase out well site Test Separators, and replace with new digital technology MultiPhase Flow Meters (MPFM) that will reduce emissions 67-90% per Case Study and measure gas volume at well pad sites for recordkeeping

OVERVIEW – OIL SEPARATION AT WELL PAD SITES

- Separators are responsible for a large amount of methane emissions.
- Separators are over a hundred-year-old technology.
- Methane seeps from separator between the **80-90 flanges** per separator.
- MultiPhase Flow Meters (MPFM) perform the same function as test separators and take oil, methane/gas and water separation into the digital age
- MPFM's replace test separators while **reducing emissions 67-90%** per case study
- MPFM have gained approval for allocation per states
- Multiple international manufacturers of MPFM's
- MPFM technology is not only less expensive to purchase and install, MPFM technology is less expensive to maintain / lower CAPEX & OPEX
- MPFM technology has less than 10 flanges, typically **7 flanges**

TEST SEPARATORS – HISTORY & OVERVIEW

- Separators were originally developed in 1890
- Separators use gravity in a large tank, and rely on gravity that forces the water to the bottom of the tank, oil to skim into a separate section of the tank, and the methane rises
- Oil and gas well pad design has both test separators, that measure individual well performance/allocation, and a larger production separator where oil is collected for custody transfer to be sold
- Typical well pads have four test separators, and a larger production separator
- Data for product within the separator (oil, methane/gas, water) is retrieved on average once a month with manual samples
- Typical separators have 80-90 flanges per case study
- Methane seeps from the flanges



Multi-Phase Flow Meters (MPFM) – HISTORY & OVERVIEW

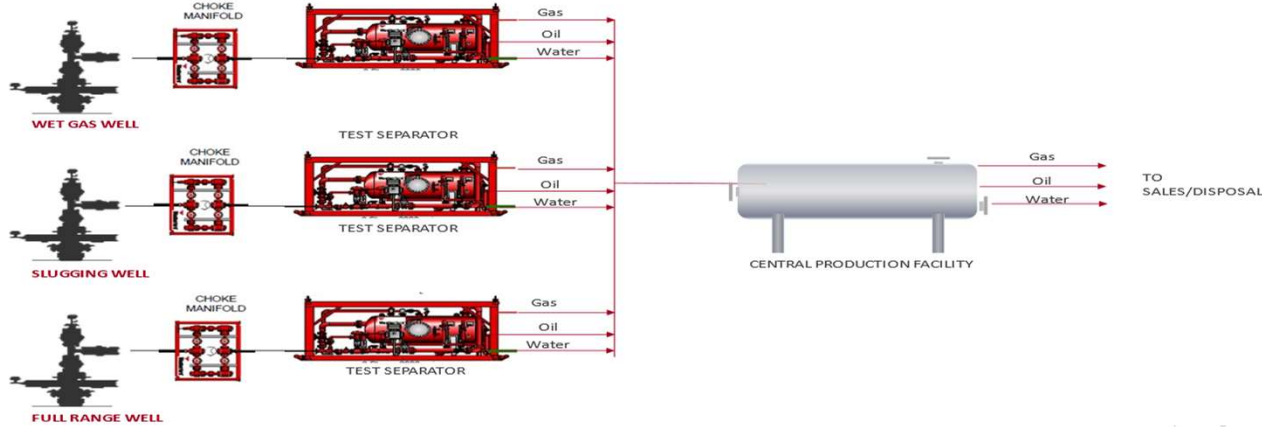
- Development started in 1980's
- 1994 installation numbers steadily increased
- 2006 estimated 2,700 installed in field
- Measurement technology has significantly increased
- MPFM replace test separators
- Multiple manufacturers have developed environmentally technologies that include sonar, microwave, infrared and more
- **MPFM technology have historical data logs that can measure gas flow rates and theoretically measure all methane/gas traveling through the site**
- MPFM technology includes real time online data that allows the operator to access all flow rates within oil, methane/gas, & water that allows for better ESG decision making
- **Methane emissions reduced from 67-90% per case study due reduction of approximately 75-80 flanges per test separator**



Separator vs MPFM: Well-pad Equipment Methane Emissions Estimates per Case Study

<u>Methane Emissions</u>	Total scf/day	vs		Total scf/day	Reduction
5 Separators	3432		1 separator + 5 MPFM	965	72%
6 Separators	4118		1 separator + 6 MPFM	1021	75%
18 Separators	12356		3 separators + 18 MPFM	3065	75%
6 Separators	4118		6 MPFM	335	92%

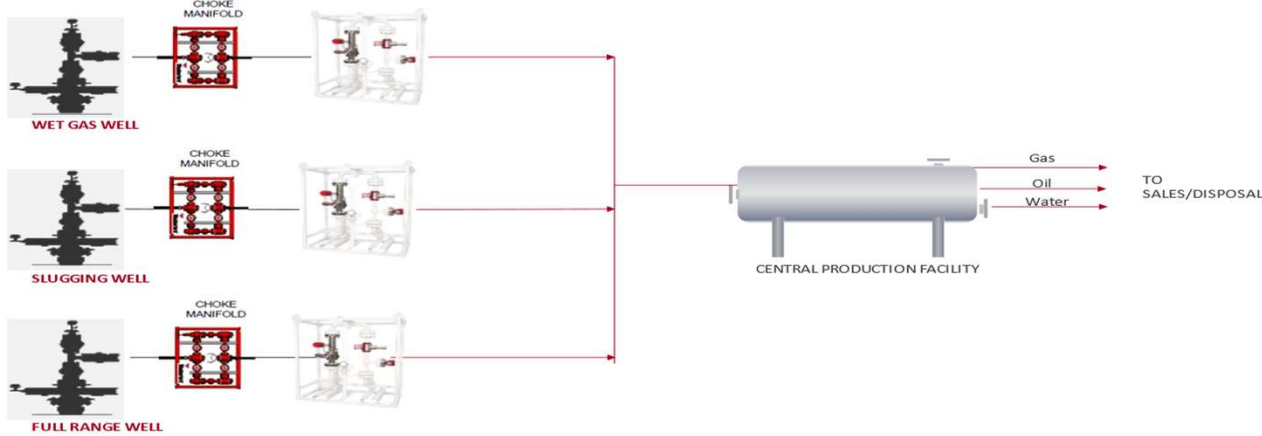
INDIVIDUAL WELL MEASUREMENT



Same well pad design

Test Separator

INDIVIDUAL WELL MEASUREMENT



MPFM

Separator vs MPFM: Top Reasons for Simplifying Well-pad using MPFM Technology

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Emissions:

1. Primary Objective: Reduce Scope 1 emissions by 67% (Case Study - Estimates) by reducing flanges/threaded connections
2. Allows for central VRU (vapor recovery unit) – eliminates venting from the storage tanks to reduce emissions further.
3. Lower carbon (eliminate/minimize vessel blowdowns)
4. Avoid Waste Emissions Charge (WEC) on excess CO2 emissions from Methane Emissions Reduction Program under Inflation Reduction Act implemented in 2024
5. MPFM should store historical logs of gas volume that could determine volume of methane traveling through instrument
6. Oil and Gas Climate Initiative (OGCI) – AIMING for ZERO, Methane Emissions Initiative, By 2030

Financial:

1. Well-pad CAPEX and OPEX savings approximately 50%
2. Easier to install, estimate 13-18% total project savings as a replacement, simple pipe modification
3. Power consumption approximately 62% less –
Instrument air controller system using test separator requires 40hp, MPFM requires 15hp.
4. MPFM's gaining acceptance by States for allocation
5. Minimize shutdown/curtail due to MPFM uptime increases revenue
6. Real time data for immediate decision making

Separator vs MPFM: Top Reasons for Simplifying Well-pad using MPFM Technology

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Maintenance:

1. No moving parts
2. Replaces logistically and operationally demanding field test separators
3. Minimal manpower and human intervention – real time data, remote monitoring, diagnostics, and operation
4. Reduced maintenance – Fewer IG/IA users. Per test separator: 2 level controller, 1 blanket gas
5. Minimal hardware and instrumentation maintenance
6. Remote maintenance: reduced venting and field visits
7. 1 MPFM vendor versus 7-10 vendors for test separators

Lean Infrastructure/Process Control (if applicable):

1. Reduced footprint approximately 80% - spillage and permitting
2. Real time well fluid management and diagnostics, more data equals better decision making
3. Enable real-time gas lift/ESP optimization
4. More flexible operation – flexible MPFM installation upstream or downstream of the choke manifold
5. Well site testing with manifold eliminates test lines
6. Elimination of fire tube in colder operating areas
7. No pressure safety valve
8. Minimal equipment and piping costs – single multiphase line instead of lines for each phase
9. Removes 3 pneumatic devices per test separator – water, oil & gas Level Controllers
10. Separator replacement can now run single bulk production lines from well pad, testers needed for validation only
11. Reduction in facility upsets due to elimination of level control and ANSI 600 pressure rating
12. Minimize shutdown or curtail due to MPFM uptime
13. Overall is more elegant and efficient wellsite facility infrastructure
14. Scalable solution

CONCLUSION:

MPFM's are an emerging technology that provides extraordinary ESG solutions by reducing fugitive emissions. Simultaneously, MPFM's give operators more control over their operations and ESG while being less expensive to install and maintain. The industry is challenged to change its mindset from separator equipment that has been a mainstay since 1890 to MPFM. If regulation was written such that all test separation equipment must have less than ten flanges on new construction and/or retrofits, this could also allow the State of California to measure gas volume traveling through the site with MPFM computerized data logs. If regulation shifted towards MPFM technology, the State of California would eliminate tens of thousands, if not hundreds of thousands flanges, in addition to other venting events, and reduce methane fugitive emissions in this area that no other solution can provide.

Proposed regulation:

Test separation units for new construction and retrofit/replacements shall have no more than ten flanges