The Use Of Innovative Multi-Phase Flow Meters to Achieve Superior Measurement Accuracy and Reliability, While Lowering Overall Cost of Facility

5th Annual Cost-Effective Well Site Facilities Onshore 2018

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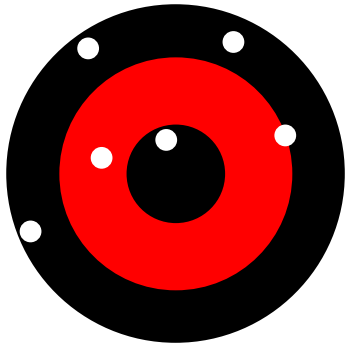
The Onshore Multiphase Measurement Challenge

- Highly accurate & reliable flow rate measurement of Oil, Gas and Water
- Meet regulatory requirements and partner allocation requirements
- Enable reservoir and well optimization
- Complex flow, changing flow conditions and fluid properties – at high GVF and WLR
- Large flow rate range from early to late life
- Little or no field intervention

Potential Solutions

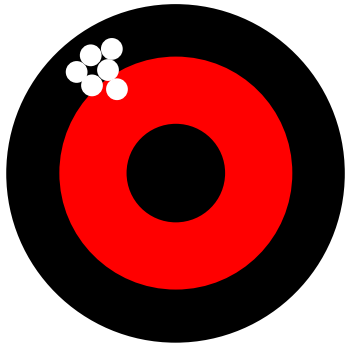
- Traditional Three Phase Separator System
  - Average over several hours
  - Requires regular maintenance
- Partial Separation MPFM System
  - Can be complex
  - Slugs can upset system
- In-Line MPFM
  - Higher oil uncertainty as GVF and WLR increase
  - Typically more technology based – Black box

Measurement Uncertainty



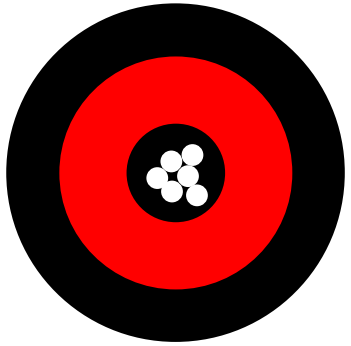
Poor Precision — Varying flow regimes, Water injection,

Poor Uncertainty — Fluid property changes, etc.



Good Precision — Meter able to handle variations (GVF/WLR)

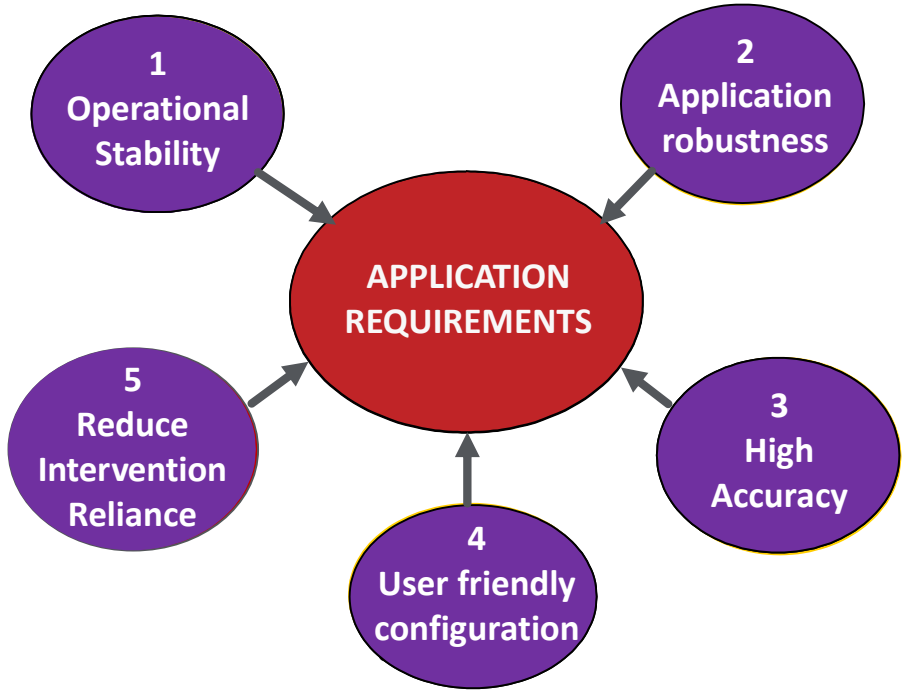
Poor Uncertainty — Fluid properties may be wrong (changed)



Good Precision — Meter able to handle variations (GVF/WLR)

Good Uncertainty — Meter able to handle fluid property changes

Oil Company Driven Development



MPM meter was developed in response to industry needs for better multiphase & wetgas meters.

Goals were defined by oil companies' application requirements

Goals set at project start were all achieved – results were implemented as technology features

Joint Industry projects (JIP) with:

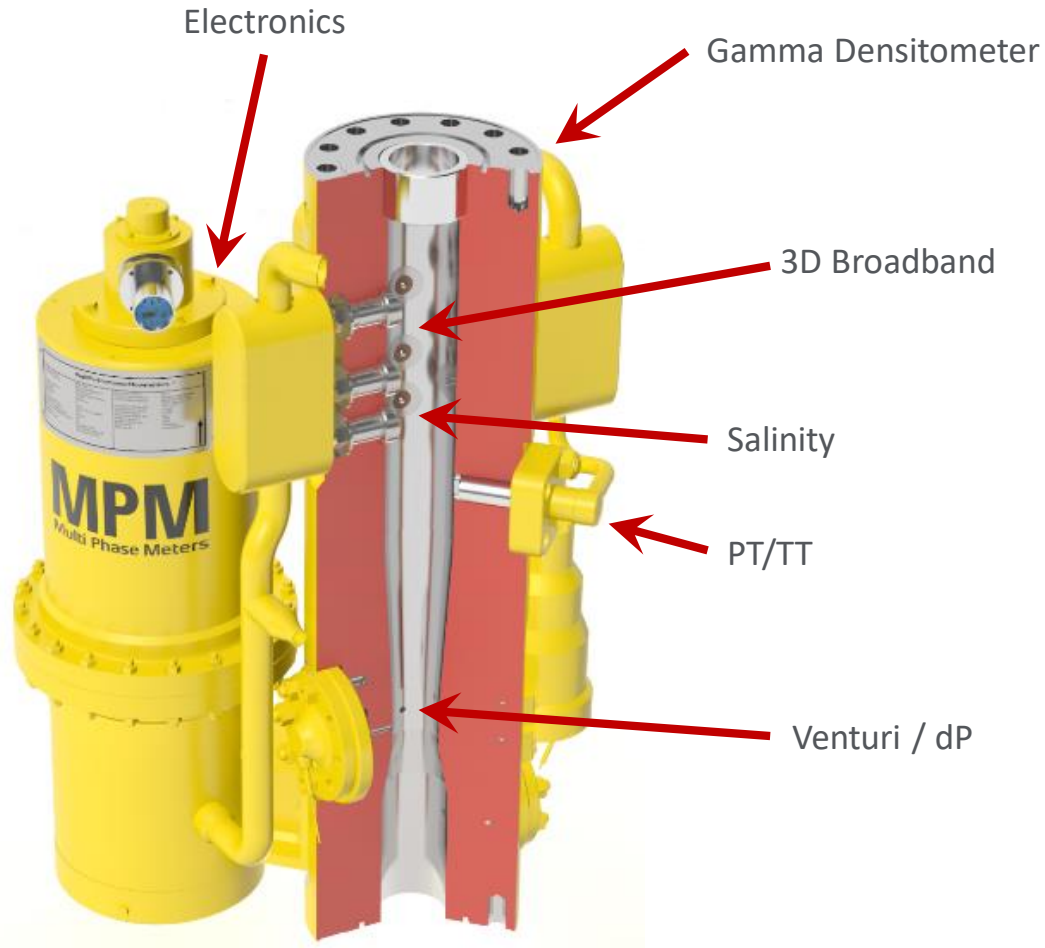
ConocoPhillips, Chevron, Eni, Gaz de France, Shell, PETRONAS, Statoil, Total, woodside, Anadarko Petroleum Corporation, Petroleum Development Oman

Innovative Technology Solution

- Combined Multiphase & Wetgas meter
- Good accuracy also for high GVF and WLR
- Low sensitivity to fluid property changes
- Self configuration – measure and compensate for changing conditions
- Extensive installed base in subsea and topside applications worldwide
- Extremely reliable – designed and built for 30 years of continuous operation

MPM Technology Overview

- Multiphase Flow Meter for Subsea, Offshore and Onshore applications
- Accurately measure Oil, Gas and Water for full range of GVF / WLR
- Fiscal Allocation, Royalty, Well Testing, Well Optimization
- Same technology for all application (subsea / topside / onshore)
- Integrated into TechnipFMC system solutions
- Remote service and support



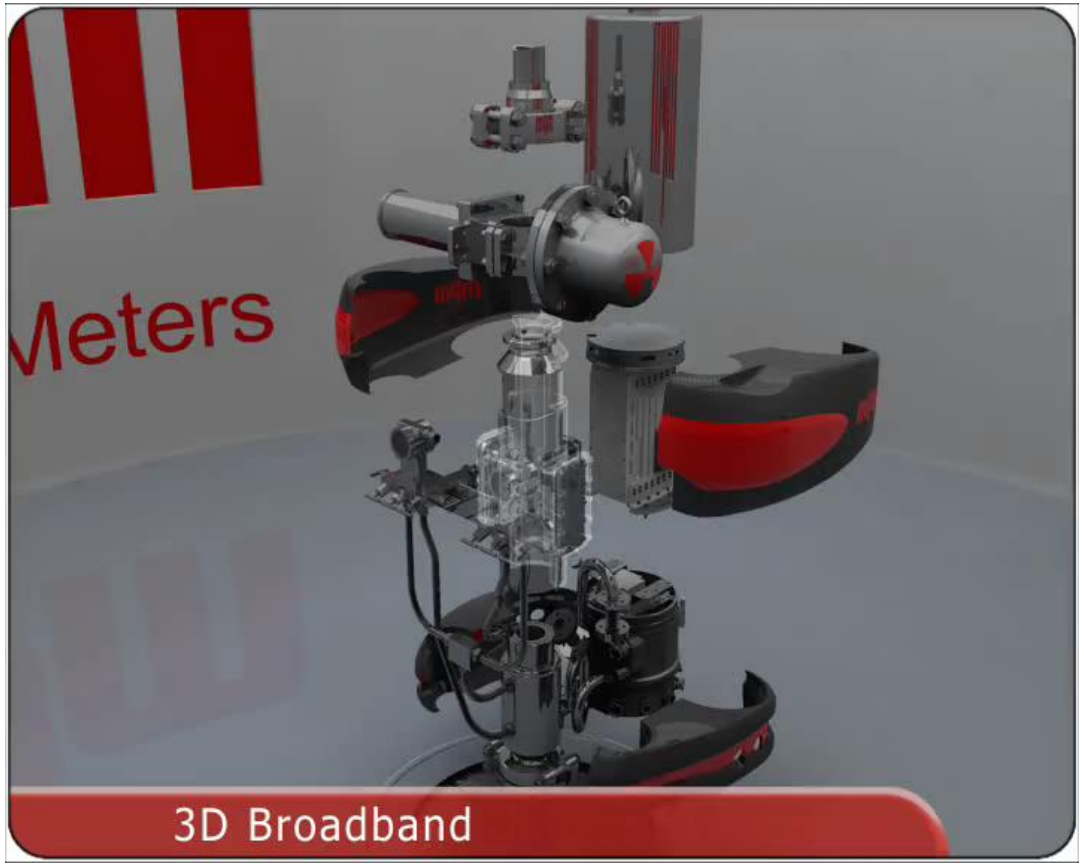
MPM Technology Overview

Next generation multiphase / wetgas meter: Tomography measurements – similar to what is used in medical industry.

X Ray

Tomography

3D Broadband (Tomography)

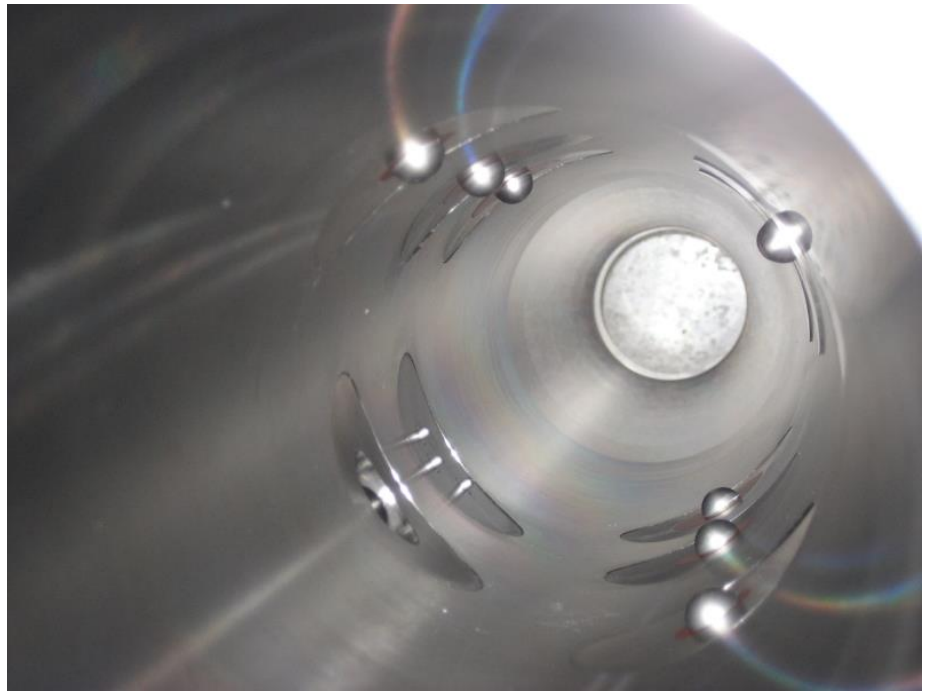


3D Broadband® measurements

The patented 3D Broadband™ system is using electromagnetic (EM) wave signals to determine:

- Watercut (WLR)
- Composition (% oil, water and gas)
- Water salinity
- liquid / gas distribution within the pipe cross section.
- Slug information – flow changes in longitudinal direction
- Droplet Count (ultra high GVF)

3D Broadband® sensors - Qualified for HP/HT

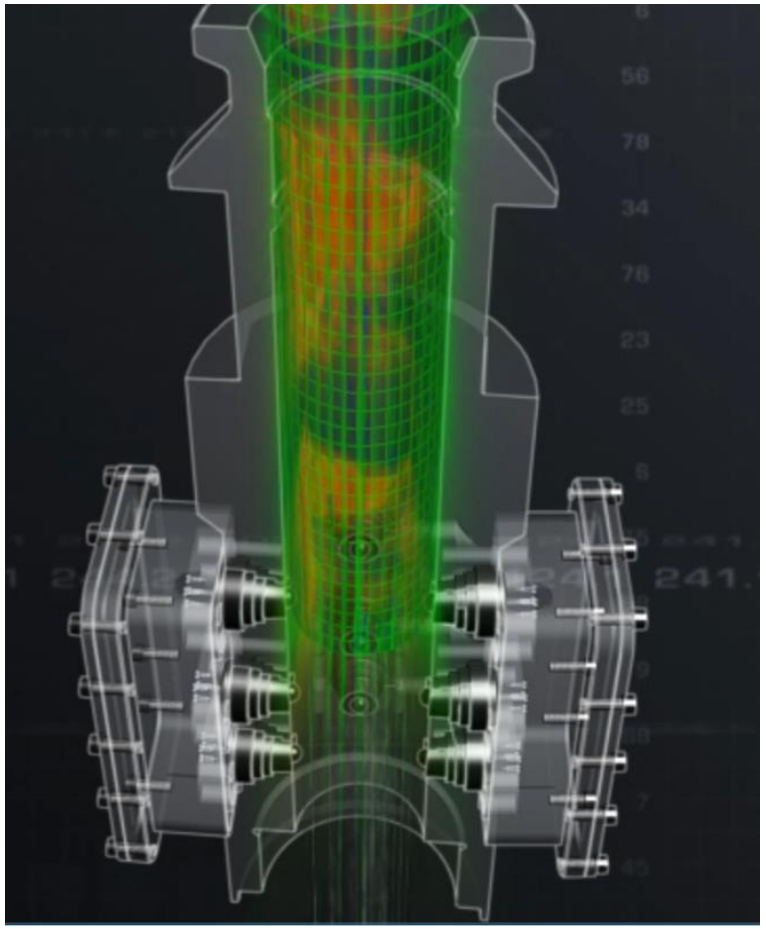


The antennas are located inside the pipe:

- 9 single-pin antennas
- 1 salinity probe (3 pins)

Dual Mode™ – Multiphase and Wetgas

- Rapid variation in instantaneous GVF
  - A well with 85% GVF(average) will in fact rarely have an actual GVF of 85%
    - The GVF will be very high, close to 100% when the gas is passing
    - the GVF is much lower than 85 % in the liquid slugs
- Oil/water continuous with sudden gas pockets, or vice-versa
- Necessary to switch measurement modes between multiphase and wet gas, up to 5 times per second



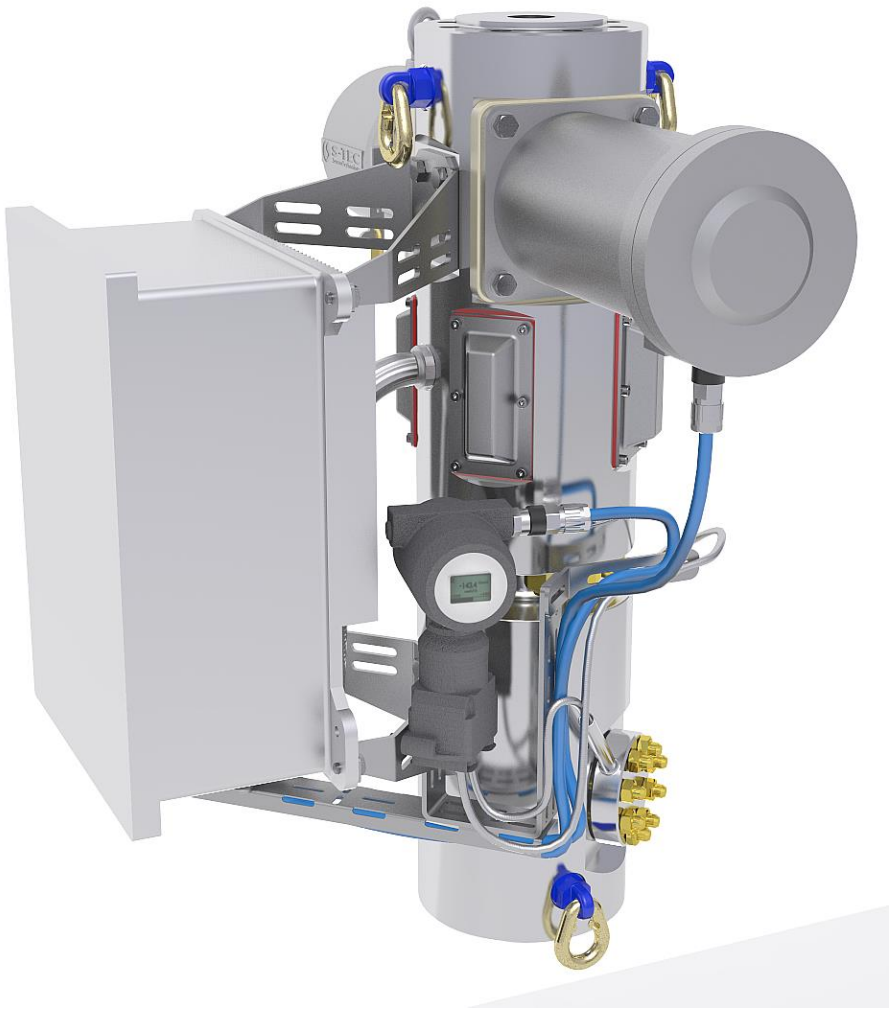
Diagnostics & Maintenance

- In-situ verification and diagnostics
  - Measures fractions and flow rates in many different ways
  - Measures and automatically compensates for fluid property changes
- Remote diagnostics
  - Meters report any concerns or issues
  - Remote connection for diagnostics
- Field calibrations
  - Regular calibration of MVT

A Multi Phase Meter for Every Application

TechnipFMC

Onshore MPM Meter



- Compact Design
- Replaceable bolt-on venturi section – extending range, lowering life cycle cost
- Identical technology and software to subsea and offshore MPM meters
- Multiflash™ equation of state integrated, accurate standard condition results
- Integrated TechnipFMC solutions offered

Summary

- Highly successful technology from 10+ years of subsea and topside use – now available for onshore applications
  - Very tolerant to fluid property changes
  - Measures accurately even with slug flow (MPM meter actually likes slug flow!)
  - Vertical up or down flow, with interchangeable venturi sections for extended range
  - In-situ verification, diagnostics and self configuration – greatly reducing field intervention
  - Meets the requirements even for the challenging conditions seen in the onshore shale applications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