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

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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:
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.
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)

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
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