FISCAL METERING SYSTEM DESIGN

- some design evaluations with respect to lifecycle cost/benefit

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Design Categories

Case: Liquid Metering Station

• Design
  – Conventional liquid metering station with volume prover
  – Liquid metering station with master meter and portable prover connections
  – Liquid metering station with master meter (no inline proving)
  – Multi-phase metering

• Configuration
  – Serial configuration
  – Parallel configuration
  – Z-configuration
Evaluation Criteria

• Price and delivery time (project phase)
  – Cost of parts, engineering, complexity

• Accuracy
  – Conformance to fiscal accuracy requirements

• Functionality
  – Flow range, online maintenance, online calibration, online diagnostics

• Reliability / Maintenance cost
  – Maintenance and diagnostics facilities, complexity, maintenance intervals, knowledge for maintenance
## Evaluation – Design Categories

+ Advantage  
- Disadvantage

<table>
<thead>
<tr>
<th></th>
<th>Price and delivery time</th>
<th>Accuracy</th>
<th>Functionality</th>
<th>Reliability / Maintenance</th>
<th>Sum</th>
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</thead>
<tbody>
<tr>
<td>Conventional with volume prover</td>
<td>-</td>
<td>+</td>
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</tr>
<tr>
<td>Master meter and portable prover connections</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>++</td>
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<tr>
<td>Inline meters only</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>--</td>
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<tr>
<td>Multi-phase metering</td>
<td>+</td>
<td>-</td>
<td>0</td>
<td>-</td>
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</table>
Liquid Metering Station with Prover
Liquid Metering Station with Master Meters
Liquid USM Metering Station
- no master meter or proving facility
# Evaluation – Design Configuration

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<tr>
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<tr>
<td>Serial configuration</td>
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<td>Parallel configuration</td>
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<td>+</td>
</tr>
<tr>
<td>Z-configuration</td>
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Serial vs. Parallel Configuration

Two meters in series

Two meters in parallel

- Correlation vs. Rel. comb. std. uncertainty [%]
- Percentage of flow in pipe 2 vs. Rel. comb. std. uncertainty [%]
Flow Measurement Technologies

- **Liquid**
  - PD (Positive Displacement) Meters
  - Turbine Meters
  - Ultrasonic Meters
  - Coriolis Meters

- **Gas**
  - DP Meters (Orifice, Venturi)
  - Cone Meters
  - Ultrasonic
  - Coriolis
## Evaluation – Flow Measurement Technologies - Liquid

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<th>Sum</th>
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<tbody>
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<tr>
<td>Liquid Turbine</td>
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<td>0</td>
<td>+</td>
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<tr>
<td>Liquid Ultrasonic</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Liquid Coriolis</td>
<td>+</td>
<td>0</td>
<td>+</td>
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**Notes:**
- `+` indicates high performance.
- `-` indicates low performance.

**Summary:**
- Liquid PD: Low performance across all metrics.
- Liquid Turbine: High performance in price and delivery time, medium in accuracy.
- Liquid Ultrasonic: Low performance in all metrics.
- Liquid Coriolis: High performance in price and delivery time, medium in accuracy and reliability/maintenance, highest in functionality.
PD Metering Station
Coriolis Metering Station
# Evaluation – Flow Measurement Technologies - Gas

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<td>Gas Cone</td>
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<td>+</td>
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<tr>
<td>Gas Coriolis</td>
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Gas Metering Stations
Important Issues in the Project Phase

• Metering knowledge at Operator / Contractor
• Calibration arrangement (provers, master meters)
• Proven technology
• Combine measurement techniques
• Quality (fluid property) measurements

Preferred solution:

• **Solid technical design based on proven technology including inline calibration/verification arrangement**