“Bundled Waveguide Technology”
RELIABLE & ACCURATE Feed Flow Measurements
More **RELIABLE** Feed Flow Measurements

- Provide Dependable Feed Flow Rate Information
- Provide a Safer Environment
- Reduce the Risk of Furnace Trips
- Prevent Product Loss
More RELIABLE Feed Flow Measurements

• Improve Low-End Reliability during Startup & Shutdown
• Reduce the Risk of Fire & Equipment Damage
• Safer Unit Operation
• Increase Production
More **ACCURATE** Feed Flow Measurements

- Optimize Furnace Load Balancing & Zone Flooding Control
- Improve Control of Drum Fill Times
More **ACCURATE** Feed Flow Measurements

- Efficient Application of Velocity Steam
- Reduce Tube Fouling Rates
- Reduce Tube Bend Wear
- Increase Heater Run Lengths
More **ACCURATE** Feed Flow Measurements

- Improve Mass Balance & Recycle Rate Accuracy
- Provide Accurate Measurement of Unit Productivity
Increase Delayed Coker Capacity

• Eliminate DP Impulse Lines
  • Injecting Purge Fluid, Reduces Unit Capacity
  • Product Loss (Purge Fluid/HCGO) is not 100% Recoverable
Increase Delayed Coker Productivity

• Reduce Tray Temperature Control Span
  (More Accurate “Pump-Around” Flow Measurement Accuracy)
  • Improve Boiling Point Control
  • Increase Yield
  • Reduce Recycle Rate
Reduce Maintenance Man Hours

- Reduce Exposure Time in the Unit & Risk of Injury
- Reduce Maintenance Man Hours Cost
The Solution?

Bundled Waveguide Technology (Sensor Type)

Ultrasonic “Transit Time” (Flow Measurement Technology)

Panametrics (GE Sensing) Flare Gas Flowmeters
Flare Gas Measurement Standard for Refineries, Since 1982
Ultrasonic Flow Measurement Technology

- Alternate “Transit Time” Measurements (Upstream & Down)
- Measured Delta T is Proportional to Velocity (Linear)
- High Turndown
- Zero Pressure Drop
Bundled Waveguide Technology

- Superior Reliability for Coker Feed Flow Measurements
- Repeatability: +/- 0.5% of Reading
- Accuracy: +/- 1% of Reading
- No Obstruction to Flow
- No Pressure Drop
- No Recalibration Required...Ever
Bundled Waveguide Technology

- Retractable Sensors under Flowing Conditions
- No Impulse Lines to Maintain
- 80% Reduction in Maintenance Man Hours Required
- Can Match Existing Wedge Element Face-to-Face Dimension
“Bundled Waveguide Technology”
Superior Performance for Coker Feed/Heavy Resid
More RELIABLE Feed Flow Measurements

Bundled Waveguide Technology

- Provides Totally Dependable Feed Flow Rate Information
- Reduced Risk of Fire, Personal Injury or Equipment Damage
- Significantly reduces the Risk of Furnace Trips

(due to Feed Meter Unreliability)
More RELIABLE Feed Flow Measurements

Bundled Waveguide Technology

• Superior Low-End Accuracy & Reliability, during Startup
• Significantly Safer Unit Operation
• Reduced Risk of Fire, Personal Injury & Equipment Damage

Linear Relationship
Over 0-100% of Range

Delta T
(Tup - Tdn)

Fluid Velocity
More **ACCURATE** Feed Flow Measurements

**Bundled Waveguide Technology**

- Optimizes Furnace Load Balancing & Zone Flooding Control
- Provides for more Accurate Control of Drum Fill Times
- Increases Batch Efficiency & Unit Productivity
More **ACCURATE** Feed Flow Measurements

**Bundled Waveguide Technology**

- Provides for more Efficient Application of Velocity Steam
- Reduces Tube Fouling Rates
- Increases Heater Run Lengths
- Increases Productivity
More **ACCURATE** Feed Flow Measurements

**Bundled Waveguide Technology**

- Significantly Improves Mass Balance Accuracy
- Provides for More Accurate Recycle Rate Calculations
- Enables the Accurate Measurement of Unit Performance
- Helps Improve Unit Efficiency & Productivity

<table>
<thead>
<tr>
<th>Sample N°</th>
<th>Density (kg/m³)</th>
<th>Yield (%)</th>
<th>Sample N°</th>
<th>Density (kg/m³)</th>
<th>Yield (%)</th>
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Increase Delayed Coker Capacity
Bundled Waveguide Technology

• Eliminates the Need for DP Impulse Lines & Purge Fluid
• Increases Unit Capacity
• Reduces HCGO Loss
Increase Delayed Coker Productivity
Bundled Waveguide Technology

• Reduces Tray Temperature Control Span (More Accurate Pump Around Flow Measurement Accuracy)
  • Improves Boiling Point/Density Control
  • Increases Yield
  • Reduces Recycle
Reduce Maintenance Man Hours
Bundled Waveguide Technology

• Reduces Man Hours in the Unit & Risk of Injury
• Reduces Maintenance Man Hours Cost
Calculating Cost of Ownership

Bundled Waveguide Technology vs Differential Pressure

<table>
<thead>
<tr>
<th>Delayed Coker Furnace Feed Flowmeter Applications</th>
<th>Jon Cloyd</th>
<th>Oil &amp; Gas Flow Applications</th>
<th>+1 (832) 249-3247</th>
<th><a href="mailto:jon.cloyd@go.com">jon.cloyd@go.com</a></th>
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**Flowmeter "Cost of Ownership" Evaluation Tool**

**Bundled Waveguide Technology vs Wedgometers/Orifice Plates/DP**

<table>
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<tr>
<th></th>
<th>Traditional Solution</th>
<th>BVT</th>
<th>Notes</th>
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<tr>
<td><strong>BWT 1 Yr Benefit</strong></td>
<td>$1,113,363</td>
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<td><strong>BWT 3 Yr Benefit</strong></td>
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<td><strong>BWT NPV</strong></td>
<td>2429%</td>
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<tr>
<td><strong>Payback Period (Yrs)</strong></td>
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### Issue & Associated Impact on Profitability

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<th>Common Information</th>
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<tr>
<td>Pass lines per Furnace</td>
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<td>4</td>
<td></td>
</tr>
<tr>
<td>Feed Flow Measurements (Control - Shutdown) per Pass Line</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Number of Flow Measurements per furnace</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Taps per Pass Line (For injected purge liquid to maintain DP impulse lines)</td>
<td>4</td>
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<tr>
<td>Taps per Furnace</td>
<td>16</td>
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<td></td>
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<tr>
<td>Cost per Man Hour (Maintenance)</td>
<td>$22.00</td>
<td>$22.00</td>
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### Capital Cost of Flow Measurement Components/Application

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<tr>
<th>Capital equipment costs for one measurement</th>
<th>$12,464</th>
<th>$18,964</th>
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</thead>
</table>

- Consider all components including valves, impulse lines, taps
- Include cost of one meter installation

**Total capital equipment and installation costs**

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<tr>
<th></th>
<th>$ 99,712</th>
<th>$ 151,712</th>
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</table>

### Profit Loss, Due to Injected Purge Fluid to Maintain DP Impulse Lines

<table>
<thead>
<tr>
<th>Purge Liquid Volume Injected per Tap (BBL/Dag)</th>
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<tbody>
<tr>
<td>Purge Liquid Volume Injected per Furnace (BBL/Dag)</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Profit per processed BBL of Feed</td>
<td>160</td>
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<tr>
<td>Daily lost profit per furnace</td>
<td>$ 21.50</td>
<td>$ 21.50</td>
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<tr>
<td>Annual lost profit</td>
<td>$ 3,440</td>
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<tr>
<td><strong>Annual lost profit</strong></td>
<td>$ 1,255,600</td>
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### Cost of Furnace Trip or Unplanned Shutdown

<table>
<thead>
<tr>
<th>Unit Capacity (bbl/day)</th>
<th>23,000</th>
<th>23,000</th>
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<tbody>
<tr>
<td>Profit per Barrel</td>
<td>$ 40.00</td>
<td>$ 40.00</td>
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Contact Information

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Questions & Answers