Realtime Ultrasonic Meter Testing

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Agenda

• Summary
• Ultrasonic Testing 101
• How we Accomplished our goals
• Examples of Real Results
• Perspectives on Best Practices
Forward-Looking Information and Non-GAAP Measures

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TransCanada

Using PI AF/EF and PI Vision to Improve Ultrasonic Meter Testing and Performance

CHALLENGE

Continue the success of TransCanada’s Enterprise Analytics program by looking at Gas Measurement related assets

- 500 ultrasonic smart meters; dark data;
- Manual testing process ~ 1/month;
- Improve accuracy;
- Evolve to proactive, exception based;
- Reduce impact to customers;

SOLUTION

Use PI AF/PI Vision to Ultrasonic meters; expand to other “smart” assets; Leverage Existing EA

- Configure PI AF/PI Vision templates with SME in agile approach;
- Deploy using PI AF tag auto creation of tag; Links to metadata;
- Develop PI AF tuning processes to evolve over time
- Develop process to track business impact;

RESULTS

Moving from a reactive/manual testing process to a proactive, exception based process – generating significant business value and customer success;

- Identified 75 meter issues to date;
- Considering frequency reduction or elimination of manual testing;
- Reduction in customer satisfaction issues;
- Reducing O&M and lost opportunity costs;
Ultrasonic Testing 101

Traditional Method:

• Diagnostic data pull over a 2 minute period, at most once per month
• Often requires windshield time
• Manual interpretation of results, with varying skill levels in spotting issues
• Data can be pulled during no flow conditions or miss intermittent anomalous conditions

Possible Anomalies that can be Detected in PI AF:

• Excessive velocity
• High gain
• Chord performance
• Chord Status
• Communication failure

• Symmetry deviation
• Flow profile deviation
• High turbulence
• Speed of sound deviation
• Speed of sound measured vs theoretical
Process Highlights

Create PI AF Meter “Digital Twins”:
- Sick Maihak
- Instromet
- Daniel

Build Templates w/Initial Analysis
Expressions w/SMEs

Map Tags & Metadata
- Auto tag creation
- SQL sources
- Table Lookup

Visualize & Evaluate Anomalies
Exception Basis

Tune Anomaly Expressions & Backfill

Track KPIs & Value Use Cases

3 PI Vision Templates
## Analysis Rule Example

### Event Frame Template: EF USM Symmetry Deviation

<table>
<thead>
<tr>
<th>Name</th>
<th>Expression</th>
<th>True for</th>
<th>Severity</th>
<th>Value at Evaluation</th>
<th>Value at Last Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>StartTriggerLookbackTime</td>
<td>‘=-4h’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EndTriggerLookbackTime</td>
<td>‘=-24h’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>StartTriggerSymmetryAverage</td>
<td>TagAvg('Symmetry,StartTriggerLookbackTime,'=')</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EndTriggerSymmetryAverage</td>
<td>TagAvg('Symmetry,EndTriggerLookbackTime,'=')</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SymmetryLowLimit</td>
<td>'Symmetry,LCL'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SymmetryHighLimit</td>
<td>'Symmetry,UCL'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DiagnosticInactiveTime</td>
<td>TimeEq('DiagnosticChecksActive,StartTriggerLookbackTime','=',BigState(&quot;Inactive&quot;))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Start Triggers**
- DiagnosticInactiveTime = 0 AND (StartTriggerSymmetryAverage < SymmetryLowLimit OR 4 hours)

**End Trigger**
- (EndTriggerSymmetryAverage > SymmetryLowLimit AND EndTriggerSymmetryAverage < SymmetryHighLimit)

**Advanced Event Frame Settings**
- Scheduling: Event-Triggered, Periodic
  - Period: 01h 00m 00s, Offset: 02h 12m 00s

Add a new variable, add a new start trigger

Enable analysis when created from template
Create a new notification rule template for EFG - Symmetry Deviation
PI AF Structure & Element Template Example
PI AF Automatic Tag Creation Example

- Use parameters inside tag creation templates
- Standardizes tag configuration
- Fast asset deployment
- Eliminates human error
Backfill Example

New PI AF analysis

Preview results
Visualization Example
Example 1: Flow Profile Anomaly

- Debris removed from meter tube in a matter of days
- Saved months of reduced meter certainty
Example 2: Transducer Anomaly

- Low transducer performance detected
- With PI Vision we see correlation to noise
- Noise correlates to pressure differential across control valve;
- Created knowledge – how much before negatively impacting the meter…Tune PI AF!
Example 3: Excessive swirl

- Swirl anomaly indicated partial blockage of the gas stream
- Led to prompt removal of foam caught in flow conditioner
Perspectives in Best Practices

1. Take time with your asset templates not just to map attributes to tags, but to allow AF to create your tags;

2. Utilize your templates in PI Vision – why build more than one screen for the same kind of asset?

3. Spend time with your SME/asset experts. Build their knowledge into PI AF analyses;

4. Tune PI AF Expressions over time – do not try to build the “perfect PI AF template”. Use agile methodology;

5. Track your findings, develop KPIs, and ensure business value awareness;
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