Costly Lessons Learned from Inspection Pitfalls of Coke Drums

RefComm 2019
Galveston, TX

Mahmod Samman, Ph.D., P.E.
Houston Engineering Solutions, LLC
(+1) 832-838-4894
info@hes.us.com
Company Background

[Logo images of various companies]
Overview

• Inspection of cone side of skirt attachment
• Smoothing of laser data
• Internal inspection of seam weld cracks
Inspection of Cone Side of Skirt Attachment
# In-Line Skirt

## Skirt Cracking Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
<th>Percent Cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracking at Weld</td>
<td>A, B &amp; C</td>
<td>56%</td>
</tr>
<tr>
<td>Cracking into Shell</td>
<td>A</td>
<td>43%</td>
</tr>
<tr>
<td>Cracking from Skirt OD</td>
<td>B</td>
<td>63%</td>
</tr>
<tr>
<td>Cracking From Skirt ID</td>
<td>C</td>
<td>26%</td>
</tr>
<tr>
<td>Cracking at Slots / Keyholes</td>
<td>D</td>
<td>76%</td>
</tr>
<tr>
<td>Total Cracking in Skirts</td>
<td>A, B, C, &amp; D</td>
<td>78%</td>
</tr>
</tbody>
</table>

API 1996 Survey
Shear Wave Ultrasonic Testing

[Diagram of ultrasonic testing setup with annotations and measurements]
Case Study

Through-wall crack not detected
Smoothing of Laser Scan Data
Why?

• Drill-stem vibrations
• Digital noise
Vibration Effect
Signal Distortion
Signal Filtering

The graph shows various curves labeled as smooth-3, smooth-5, smooth-7, smooth-13, smooth-21, smooth-25, and smooth-31. The x-axis represents height, while the y-axis represents radius measurement. The curves indicate different levels of signal filtering effectiveness, with smooth-31 showing the least variation and smooth-3 showing the most variation.
Signal Zoom
Case Study

Radius map

Less smoothing

More smoothing
Case Study

Bulging Severity (PSI)

Incorrect assessment of severe bulges

Less smoothing

More smoothing
Internal Inspection of Seam Weld Cracks using Alternating Current Field Measurement (ACFM)
Classic Tri-Metal Joint Cracks

- **Restoration Weld**
- **Circumferential Weld**
- **Clad**
- **Base Metal**
Common OD Cracks

- Restoration Weld
- Circumferential Weld
- Clad
- Base Metal
Almost through-wall crack not detectable using internal ACFM. Need internal AND external ACFM, UT, or AET.
Recap

• Inspection of cone side of skirt attachment
• Smoothing of laser data
• Internal inspection of seam weld cracks