



Coke Drum Resource Management Reliability Focus for Safety

Market Need

- Over 400 coke drums currently in operation and increasing annually
- Fires from through-wall cracks - safety risk
- Processing heavier crude oils
- Higher production demands
- Lost profit opportunities due to through-wall cracks (\$1MM+ each)
- High capital replacement costs
- Long lead time for replacement



Holistic Approach throughout Life Cycle



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Condition Assessment

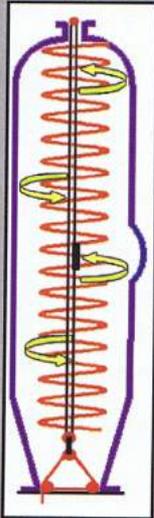
Condition Assessment

- Technologies to assess the condition of the drums while offline (or inside cycles)
 - LASER Profiling
 - Remote Video
 - Automated UT – Combined PA and Dual TOFD
 - Time of Flight Diffraction Ultrasonic (TOFD)
 - Phased Array (PA) Ultrasonic
 - Traditional UT
 - Others

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Drum Diagnostics LASER Scan & Video

Quest TruTec Advantages



- Stabilized Tensioned Cable System
- Centered/Repeatable
- Hi-Resolution
- Quick (inside cycle or during t/a)
 - Setup – 45 minutes
 - LASER Scan – 30 minutes
 - Video - Circumferential/Longitudinal welds – 60 minutes
 - Video – Problematic areas identified by LASER Scan – 30-60 Minutes
- Independent of Owner Operator Assistance
- Economical

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System Overview

LASER

- Infrared LASER Ranging Device
- Mirror allows 360° sweep
- Stabilized for sharp, high resolution image
- +/- 1/8" accuracy
- Approx. 30 readings per square inch



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System Overview

- **Video**
- High resolution color video camera
- Joystick controlled pan/tilt
- 24X Zoom
- Mechanical and electronic image stabilization



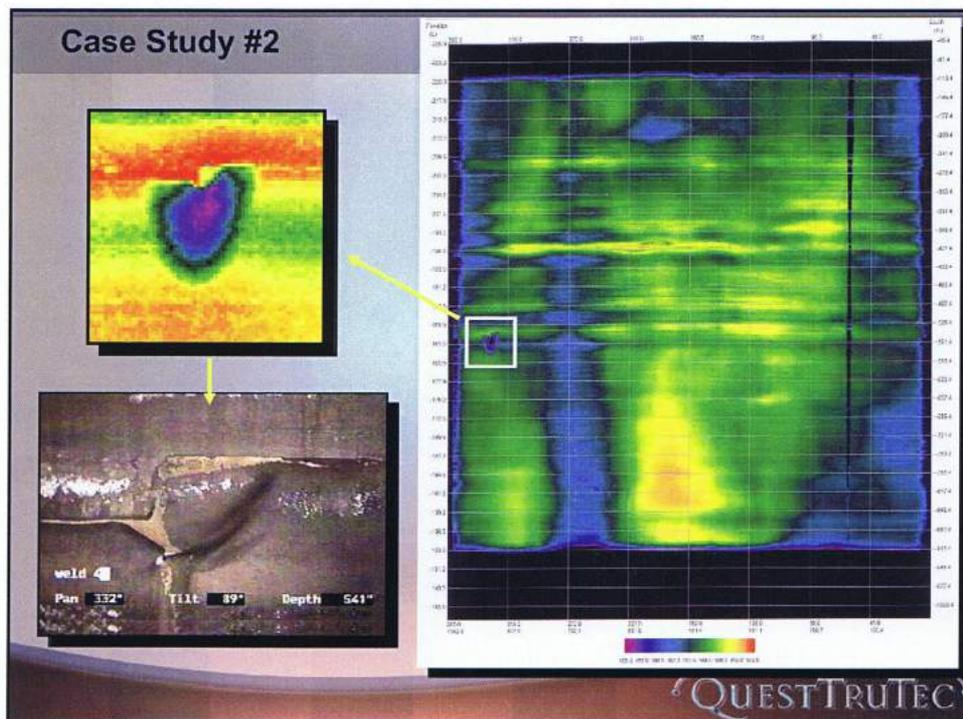
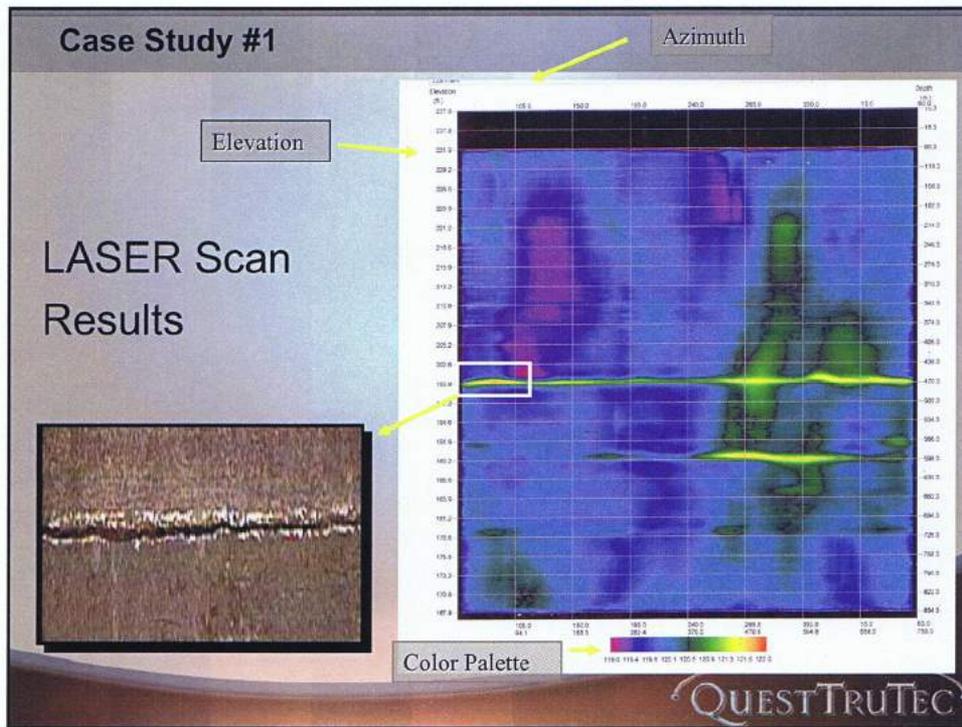
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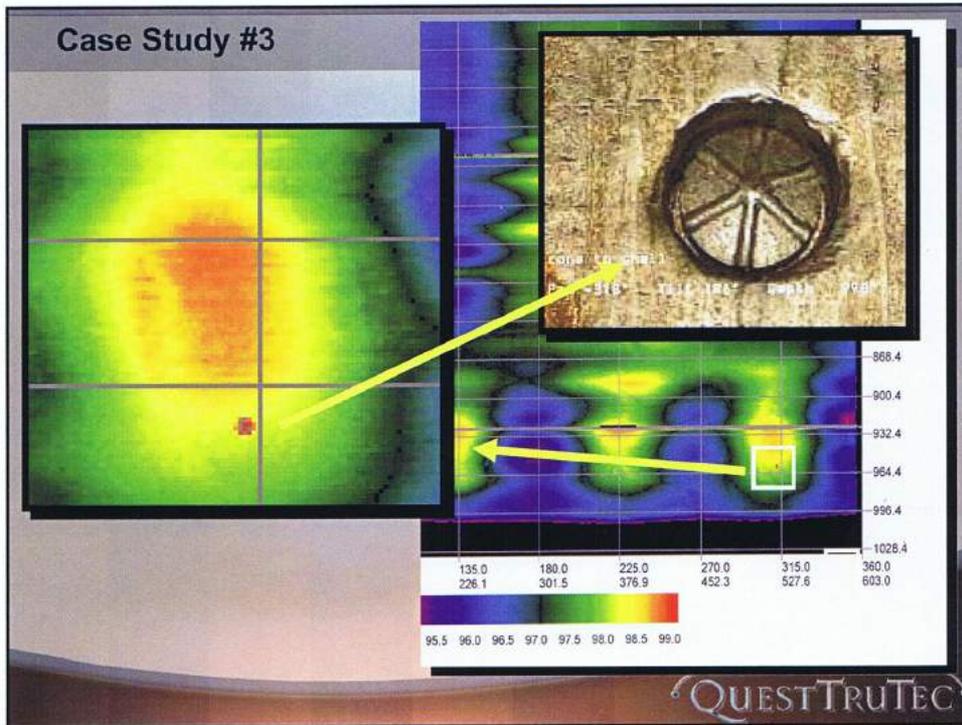
System Overview

- **Class I - Division II**
- All equipment entering the drum is pressurized and monitored.
- If pressure falls below preset limit, entire system is shut down.



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LaserView™ Software Provided

Advantages

- Side-by-side comparison of past scans
- Drill down capability
- Bulge severity indicator
- Loaded locally at client site

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AUT for Girth Weld Seams by Magnetic Crawler

- Available to perform AUT Scanning for bulges identified during Laser Scan
- Height Limitation of 8"



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Automated UT

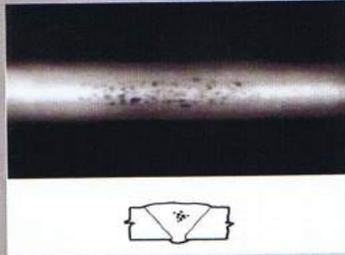
Phased Array UT Combined with Dual Time of Flight Diffraction



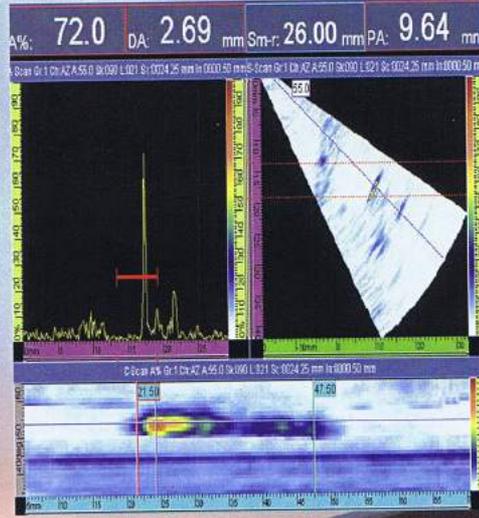
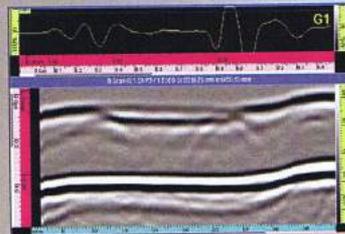
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Porosity



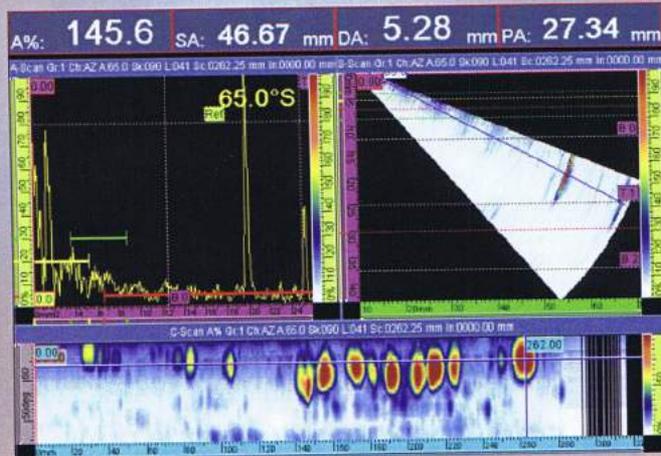
TOFD technique



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Omniscan Phased Array Inspection of Plate/Butt Weld

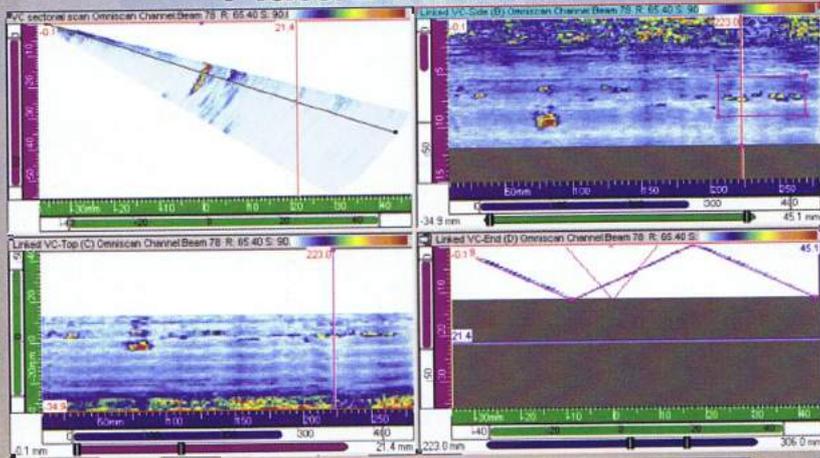


Omniscan analysis view of one-line scan using 45-70 degree sector scan. Red areas on C scan display non-fusion in the weld.

Graphics Provided by Matrix Inspection & Engineering



Omniscan Phased Array Inspection of Plate/Butt Weld



Tomoview offline (computer based) analysis of Omniscan phased array data file. S-scan, C-scan, D-scan, and B-scan displaying slag inclusions in 12.7mm V weld

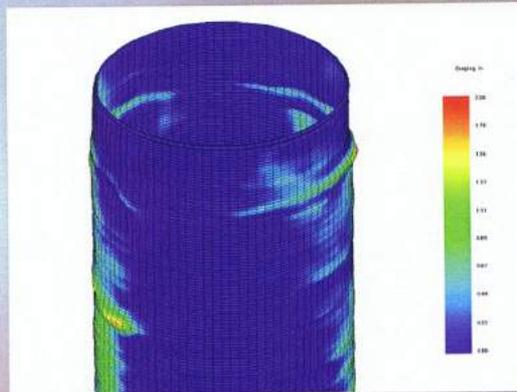
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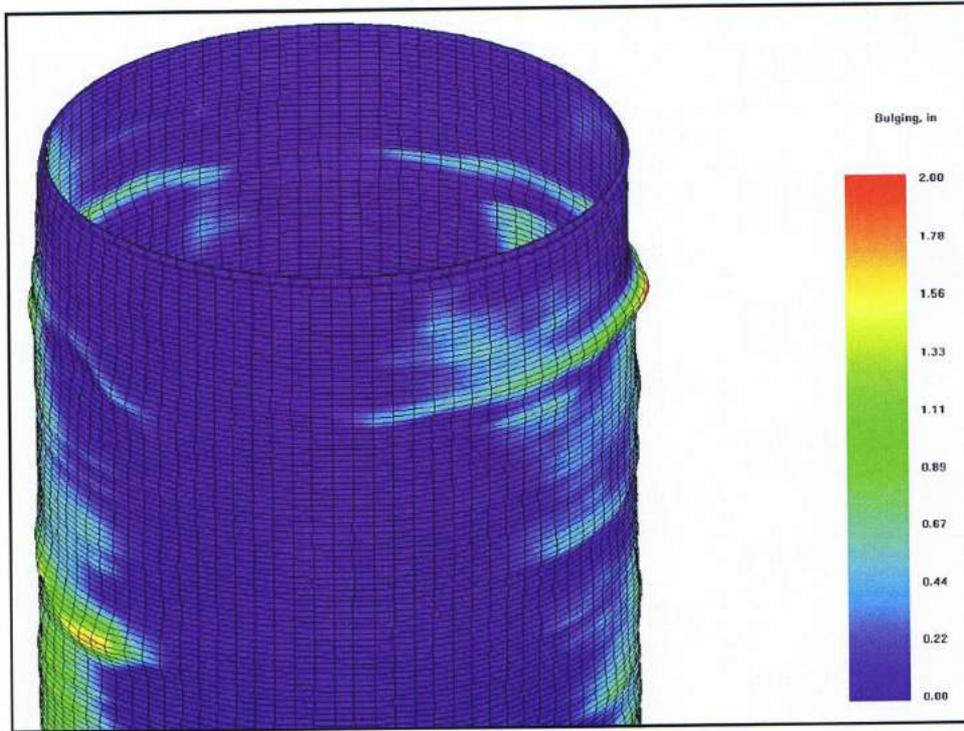
Finite Element Analysis

Finite Element Analysis

- Integrated stress analysis/life assessment software has been developed.
- LASER profile is used to create 3D finite element model of drum.
- Bulge geometry is accurately represented by FE mesh.



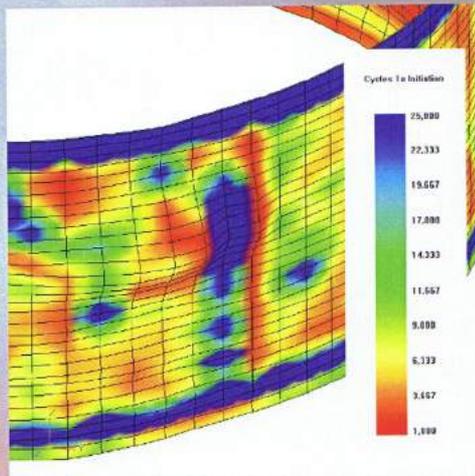
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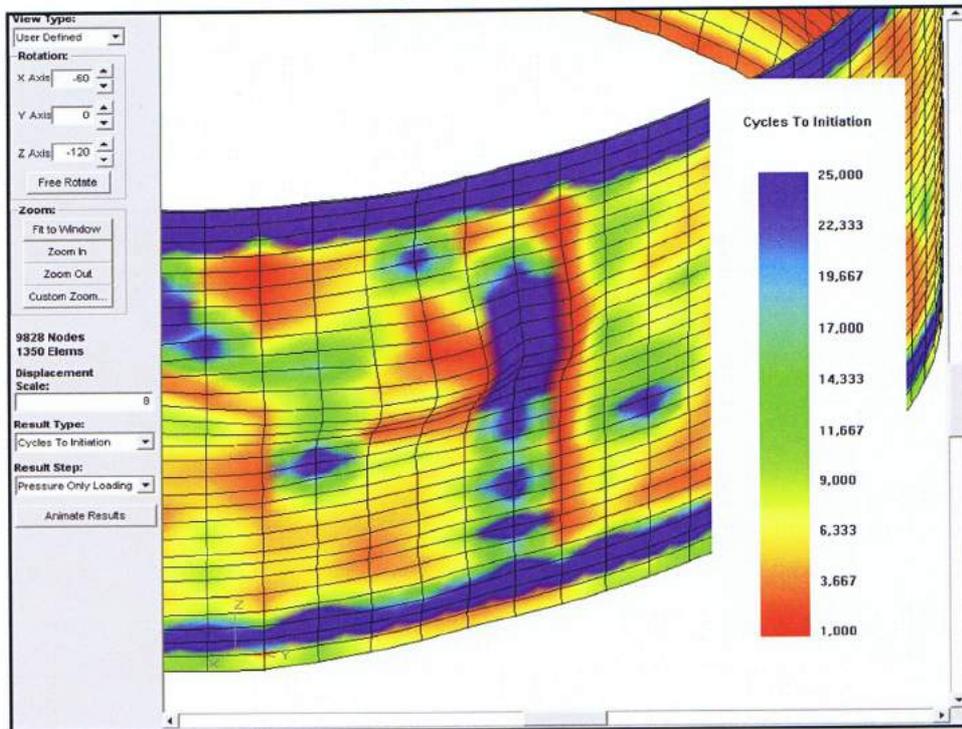
Remaining Life Assessment

Remaining Life Assessment

- Finite element model along with the field measurements are utilized to calculate “Cycles to Initiation” which is a prediction of the number of coking cycles required to initiate cracking.

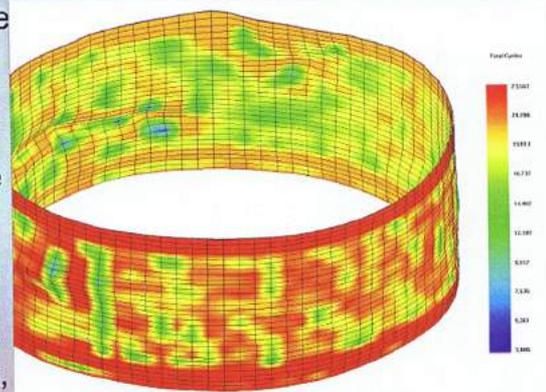


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Remaining Life Assessment

- Upon further analysis, the total cycles to through-wall cracking is determined.
- The stress analysis & life assessment can be performed onsite.
- *LifeQuest Viewer* software allows client to view 3D maps of bulging, stresses and remaining life.



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