



Cat Cracker Seminar
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Royal Sonesta Hotel
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CAT-14-103 **Slurry System Transformation**

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Agenda



- Introduction
- Whiting Refinery
- Whiting FCU Complex - History
- The slurry system problem
- Analysis
- Design Changes
- Results
 - Fouling
 - Measurement
 - Erosion
- Summary

Speaker Background



▶ Brent Novak

- 20 years Refining
- 11 years FCC
 - 5 Operations
 - 6 Technical
- 5 years Corporate Strategy
- Chemical Engineer – Notre Dame
- MBA – University of Chicago

▶ Doug Montgomery

- Mechanical Engineer – Ohio State University
- 20 years Refining
- 10 years FCC
 - 5 years FCC Maintenance
 - 3 years FCC TAR's
 - 2 years FCC Projects
- 3 years HPD Operations
- 7 years Reliability Engineer and Maintenance Consultant

Whiting Refinery

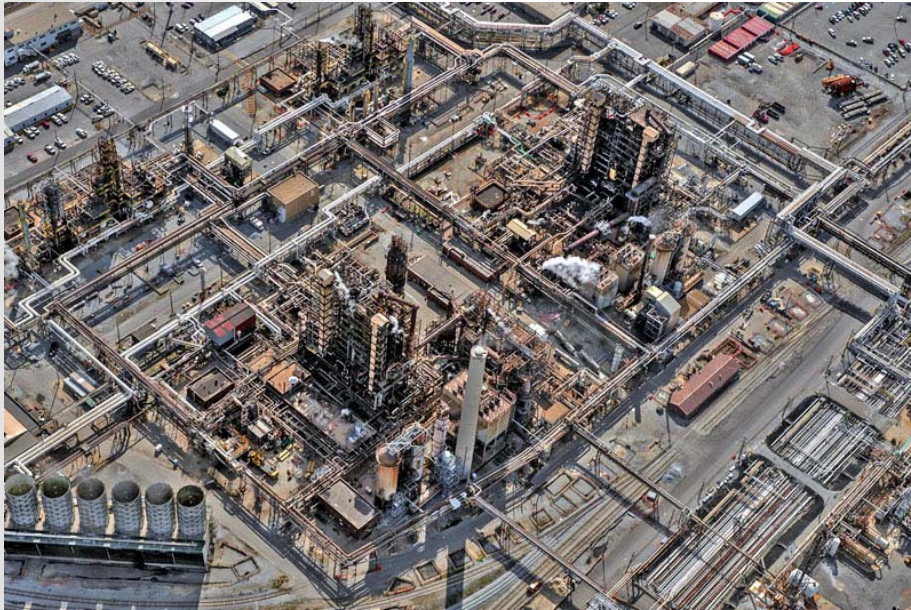


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- ▶ 428 kbd Refinery
- ▶ First opened in 1889
- ▶ Recent Modernization to process Canadian Crude

Whiting FCU Complex

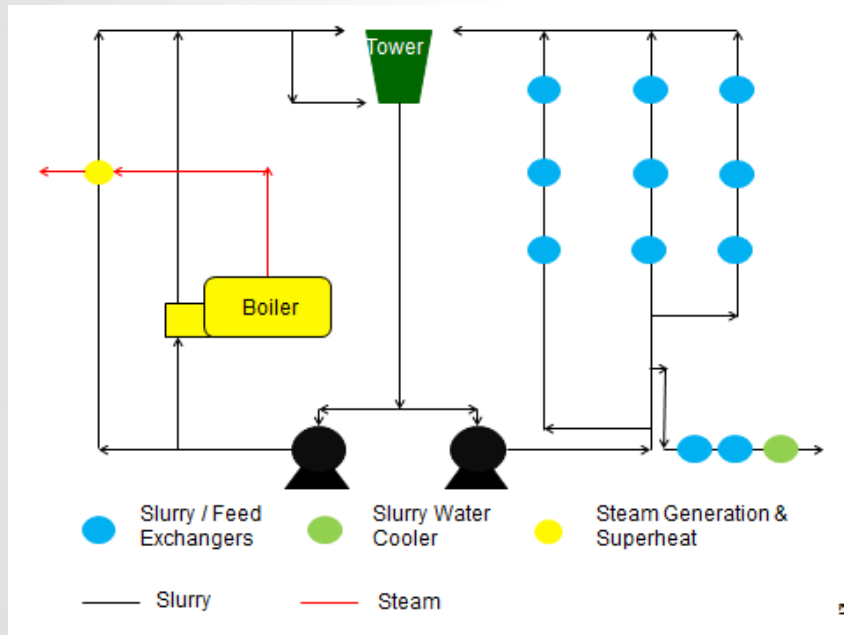


- ▶ 170 kbd Capacity
 - 105 kbd FCU500
 - 65 kbd FCU600
- ▶ Kellogg Side by Side
- ▶ Onstream since 1946
- ▶ Multiple Debottlenecking Efforts
- ▶ Current Capability established in 1980's

Slurry System Problem



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- Chronic, rapid exchanger fouling / plugging – rate limiting
- Erosion Concerns
 - ROV's
 - Orifice Plates
 - Warm up bypasses
 - Control Valve Stations
- Poor Measurement Accuracy / Precision

Analysis and Actions

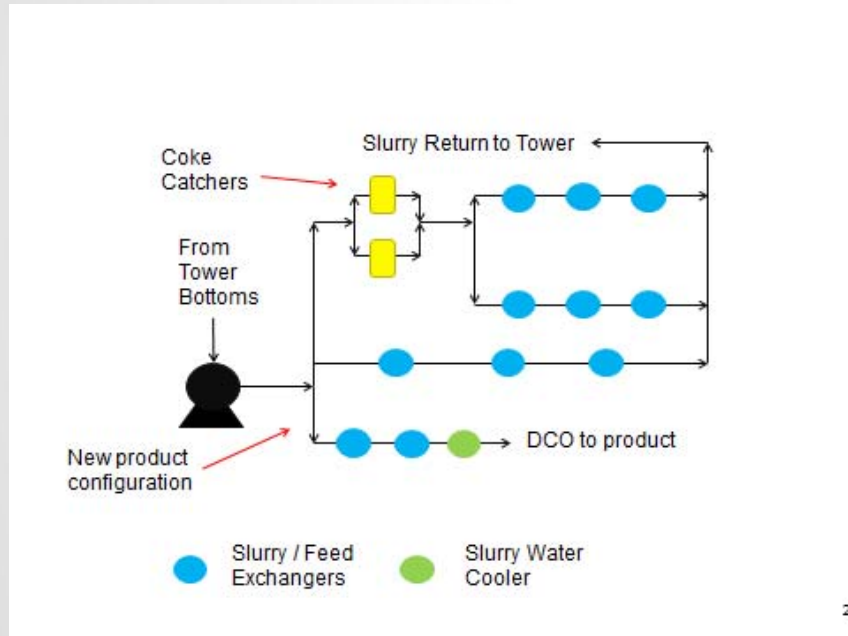


- Fouling Characterization – 3rd party review
 - Remove slurry internal recycle between units
 - Add LFO upstream of boilers and exchangers
- Improve Robustness
 - Assess Velocities & modify piping configurations to target 5 to 10 ft/s everywhere
 - System Geometry
 - Establish symmetrical exchanger piping between banks
 - Coke Catchers

2005 TAR Modifications



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- ▶ Isolate Internal Recycle
- ▶ Coke Catchers
- ▶ Piping geometry changes
- ▶ LFO upstream of boilers / exchangers
- ▶ New Measurement Technology
- ▶ Slurry Pump driver modifications

Successes from '05 TAR Modifications



- Immediate, step-change reduction in Slurry Exchanger fouling
- Slurry pump performance with VFD's
- Minimal debris seen in Coke Catchers
- Slurry pump check valve warm-up bypass elimination
- Vortex flowmeter performance (good results for 7 years)
- ROV performance (good results for 8 years)

Vortex Meter Issues

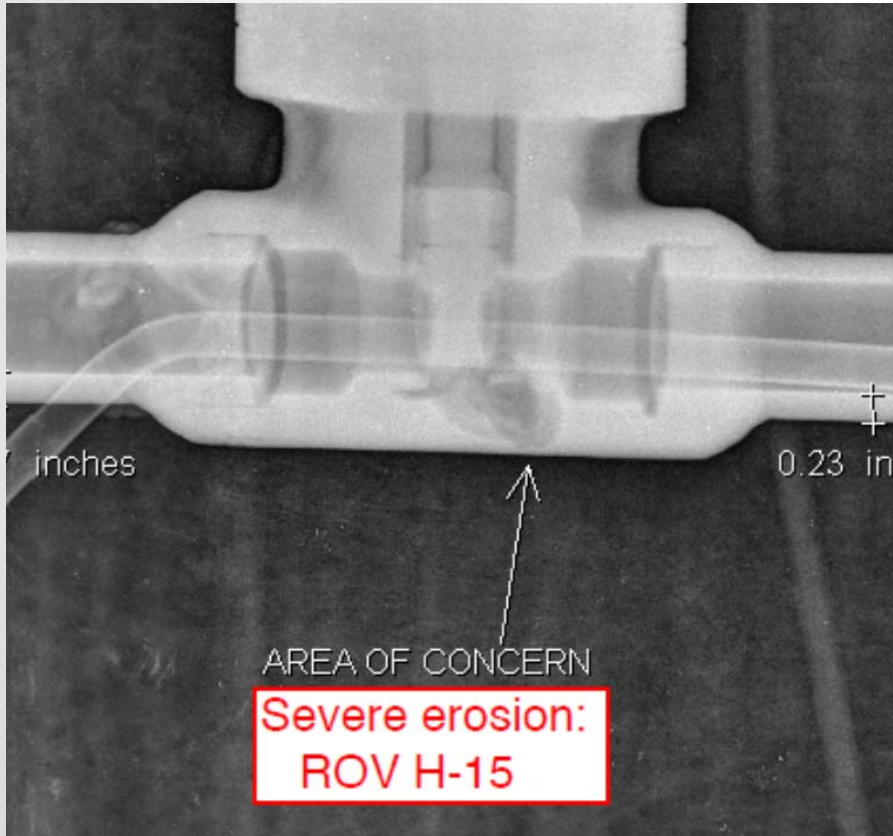


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- ▶ Good Performance for 7 years
- ▶ Erosion – LOPC
- ▶ All experienced same degradation
- ▶ Trialing Alternate Technology



ROV Erosion Concerns



- ▶ Changed design from concentric to “v-notch”
- ▶ Good operating performance – until leak.
- ▶ Localized erosion

CV Erosion Concerns



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- ▶ Harden in turbulent areas
- ▶ Improve isolation capability (double blocks)
- ▶ Concerns with leak-through CV bypasses after operation/use.

Ongoing Efforts



- ▶ Bolted Connections
- ▶ Measurement Technology
- ▶ ROV orientation / hardening / life cycle management

Summary



- ▶ Reliability and Maintenance Problems can be solved
 - Essential to first understand why the fouling is occurring (slurry fouling composition, velocities, etc.)
 - Provide upset protection
 - Make Deliberate Changes

- ▶ All Change comes with unknowns



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