Coker Fractionator Project Review:
Driving Safety and Integrity with Analytical Sophistication

Oct 22-26, 2012, Ft McMurray, ON, CN
Review of Scope

Need for Repair
• Significant Corrosion Thinning
• Large Portion of the Vessel Affected (18m Height)

Background
• Bottom portion clad with 405 SST
• Improved Corrosion Resistance Needed
• Uncertainty with extent of damage

Repair options considered
• Section Replacement
• Component Replacement
• Weld Metal Overlay

Owner Preferences
• Short duration of overlay preferred
• Structural impact concerns must be addressed

Main Fractionator Vessel
Machine Based Welding Repairs

Importance: Machine vs. Manual

Component Repairs

Repair vs. Replace

Comparison against conventional welding practices

• Control of Heat Input and Distortion
• Homogeneous Deposit Quality
• Production Rate
Welding Beneficial Stresses

Welding Stresses
• Inevitable with full fusion bond
• Must be managed through parameter control
• Must be homogeneous

Basis / Key Contributors
• Non Symmetrical structural components

Consequences
• Non Symmetrical distortion behavior

Machine applied predictability
• Allows for accurate modeling
Predicting Welding Stresses

Basis for predicting – Consistency of application

Brief review of history of Numerical Predictive Analysis

Benefits of NPA in validating repair designs
Coker Fractionator Repair Design

Repair Issues
• Improved Corrosion Performance
• Concerns about out of roundness ASME Section VIII

Objective of Repair Design
• Address structural risks
• Model Optimum Application Order

Considerations
• Improve vs. replace
• Safety, Schedule, Performance

Application of NPA Results
• 0.04% and 0.02% Deviation at Critical
Delayed Coking Coke Drum Weld Repairs

Many applications for WMO

• Circumferential Seams

• Cracks

• Cladding repair / replacement

• Cone refurbishment

• Skirt cracking repairs

• Bulging

Graphic Courtesy of Stress Engineering
NPA of FCCU Design Repair

Additional example
• FCCU Stripper/Reactor
• High Temperature Creep Failure
• 5 Year Life Extension Required

Anticipated Design Repair
• Model Existing Failure Condition
• Develop “Engineered Design Repair” to manage stress levels below creep failure limits
• Perform Level 3 FFS Analysis

Engineered Design Repair
• Reduced scope of work
• Reduced cost for repair
• Validation of repair lifetime

FCCU Stripper/Reactor Failure Area
NPA of FCCU Design Repair

Estimated Life of Repair Well in Excess of 5 Years

Areas Exceeding Creep Stress Limit

Engineered Structural Overlay

Post Overlay Stress Gradients

Regions below temperature threshold for Creep
Engineering Analysis for Fume Control

Application of CFD

Fume / Smoke Control

Ventilation Design

Temperature Control

Personnel Safety & Productivity
### Aquilex WSI / Ventilation Plan

#### Ventilation Equipment
Location of Open Inlet Nozzles and Exhaust Blower Nozzles

<table>
<thead>
<tr>
<th>Zone #1 &amp; #2</th>
<th>Zone #3 &amp; #4</th>
<th>Zone #5 &amp; #6</th>
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</thead>
<tbody>
<tr>
<td>Nozzle</td>
<td>Blower Model</td>
<td>Blower CFM</td>
</tr>
<tr>
<td>N38</td>
<td>RF-12</td>
<td>2140</td>
</tr>
<tr>
<td>N29</td>
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<tr>
<td>N35</td>
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</tr>
<tr>
<td>N40</td>
<td>ASI-1000</td>
<td>1422</td>
</tr>
</tbody>
</table>

| CFM Zone     | 8546         | CFM Zone     | 10685        | CFM Zone     | 24010        |

Total CFM all zones: **43242**

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**Air Systems / Venturi Air Blower**
- ASI-1000 (1422 CFM) @ 90 PSI
- ASI-1200 (1390 CFM) @ 90 PSI
- ASI-2000 (3752 CFM) @ 90 PSI
- ASI-4100 (5041 CFM) @ 90 PSI

**25% Efficiency** 10811

Average per weld machine 1081
Summary

Keys to Reliable Design Repairs

Weld Overlay is not a commodity

Does your organization have the specifications in place to include automated weld overlay as a viable option?

Engineered Repairs

- Machine Technology
- Tooling Development
- Welding Engineering
- FE Modeling / NPA
- Metallurgical Engineering
- Resource Depth
  - Equipment
  - Procedures / Programs
  - Trained Personnel
- Demonstrated Experience
Questions

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