DCU Support Skirt Repair & Life Extension

Presented by:

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• Coke drum skirt attachment configurations vary depending on vintage and the original design
• Low Cycle Fatigue induced damage is common at this critical location
• This presentation addresses repair options for the modified crotch design which is one of the most common configurations today
• The repair method selected varies depending on the history of damage, available repair schedule window, and the owner’s expectations on operating life.
Common Skirt Attachment Geometries

1 - “Analyses of Alternate Skirt Attachments to Coke Drums” PVP Vol. 315, Leslie Antalffy et. al., ASME 1995
Tensile Stresses
Compressive Stresses

End of Fill Cycle
Damage Mechanism

1 Hour Into Quench Cycle

Tensile Stresses

Compressive Stresses
Resulting Potential Crack Paths

Indications at top of skirt weld (1)
'knuckle joint'

Drum and skirt A387 gr.11 cl2
Weld metal ER80S-B2

Possible indications at bottom of skirt weld (2)
a. through HAZ or
b. straight through V-groove
Upper Knuckle Repair
Indications at the Upper Knuckle Weld

Common Upper Knuckle Cracking
Upper Knuckle Repair Process

Process:
1. Excavate to remove cracks & previous repairs
2. Utilize temper bead technique to eliminate PWHT
3. Re-contour geometry to minimize stress concentrations
• Additional weld metal is applied to add material for re-contouring operation to obtain improved transition geometry.
• Modified contour area is optimized to minimize stress

• Optimized Contour is applied by grinding using template created with the results of the analysis
Window Section Replacement
Window Replacement Repair

- Method is common when there is significant damage or an accumulation of previous repairs
- Facilitates alloy and geometry changes from the original design
- Proper installation techniques and welding process significantly extend life of repair
- Provides good root geometry to minimize stress risers
Window Replacement Repair

Skirt Bulging

Replacement in Progress
Window Replacement Repair

Existing Skirt Removal
Window Replacement Repair

Section Alignment Fixturing

Proper Root Opening for Welding
Skirt Section Ready for Welding
Welding Completed and Ready for Inspection
Groove Weld Repair
Groove Weld Repair

- Method is common when there is concentrated damage in the attachment weld
- Repair is not as robust because root geometry is less controllable
- Allows for “on-line” repairs which minimize production schedule
Root Geometry Concerns

- It is common to encounter previous repairs in this location.
- These repairs sometimes leave significant root misalignment.
- The resulting root geometry can magnify stresses and shortens time to new crack incubation.
Weld Joint Misalignment

Root Geometry Concerns

Groove Weld Root Misalignment
Root Geometry Concerns

Bevel Reconstruction

Reconstructed Bevel Ready for Root Pass
After root reconstruction, automated temperbead welding is used to fill and cap the groove.
• Sometimes customized weld heads are required when there are structural obstructions
Groove Weld Repair

- PAUT is used to inspect all welding upon completion.
Selection of Welding Process
Field Friendly Joint Design

- Simple Bevel on Existing Material
- J-Prep on Replacement Plate
- Allows Machine Welded Root
- Full Penetration Weld With Acceptable Root Geometry
AZZ / WSI GTAW Hot Pulse
Wire: .035" Inconel 625
240 IPM @ 32hz pulsing

Shot at 2,000 FPS with playback at 30 FPS
Joint Design & Alignment Sensitivity

Front Side

Backside
Sensitivity to Root Gap Variations

- No root gap
- 1/16” Root Gap
- 3/32” Root Gap
- 1/8” Root Gap
Automated “Hot Pulse” process from WSI used for all panel welding

- Welding Process Delivers Volumetric Quality with goo Root Profile
- GTAW Weld Deposit provides significantly better mechanical properties than SMAW and GMAW deposits
Thank You

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