Enhancing
Infrastructure

Coker Vessel Life Extension Repair Implementation

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REFCOMM
RIO DE JANEIRO
29 Sept – 3 Oct 2014

CatCracking.com

AZZ / WSI
WELDING SERVICES DO BRASIL

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Plant located in Barueri – Sao Paulo

Current projects are executed mixing Brazilian with resources coming from Europe and US

Brazilian team

Office

Petrobras REGAP (Gabriel Passos) Betim Refinery

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Structural Overlay Life Extension & Skirt Cracking Repair of Delayed Coking Unit Vessels

Petrobras REGAP (Gabriel Passos) Betim Refinery

Refinery Located in Minas Gerais, Brasil
24,000 bpd coking unit (4 coke drums designated as A,B,C & D)

As-found Conditions of the Vessels

- Skirt to Vessel Cracking at the attachment weld location
- Shell Bulging in drums C&D which will lead to crack formation

Several repair options were evaluated for the repair:

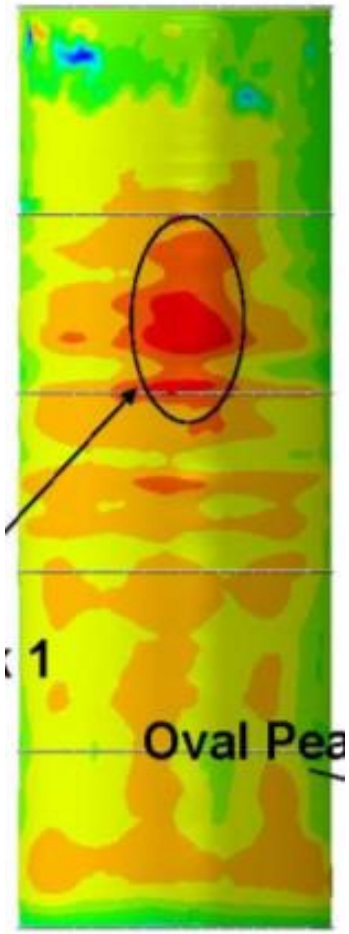
Option	Implementation Schedule	Repair Complexity	Repair Integrity
Window Replacement	Long	High	Low
Section Replacement	Long	High	Medium-Low
Structural Overlay	Short	Low	High

Engineered Structural Overlay selected. New technology application for Petrobras. Significant Research and development performed with CENPES to evaluate and qualify this repair process.

Typical Shell Bulging Example

Bulged Area in Coke Drum

- Common Condition in DCU Vessels
- Associated with low cycle fatigue
- Conventional repair methods have not performed well historically
  - Section Replacement
  - Window replacement



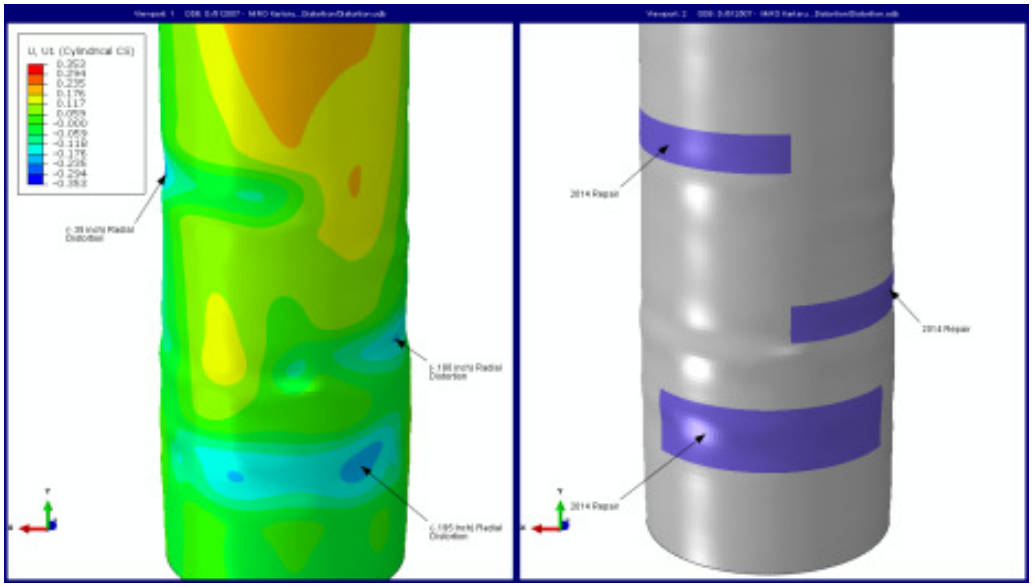
120° (SE)

Typical Laser Mapping Data

Petrobras REGAP (Gabriel Passos) Betim Refinery

With the Laser Mapping Information and the detailed operating parameters of the vessel, a structural overlay can be designed to significantly modify the structure of the vessel in the affected area to significantly increase fatigue life.

Automated Welding System
Applying Inconel 625 in Pressure Vessel

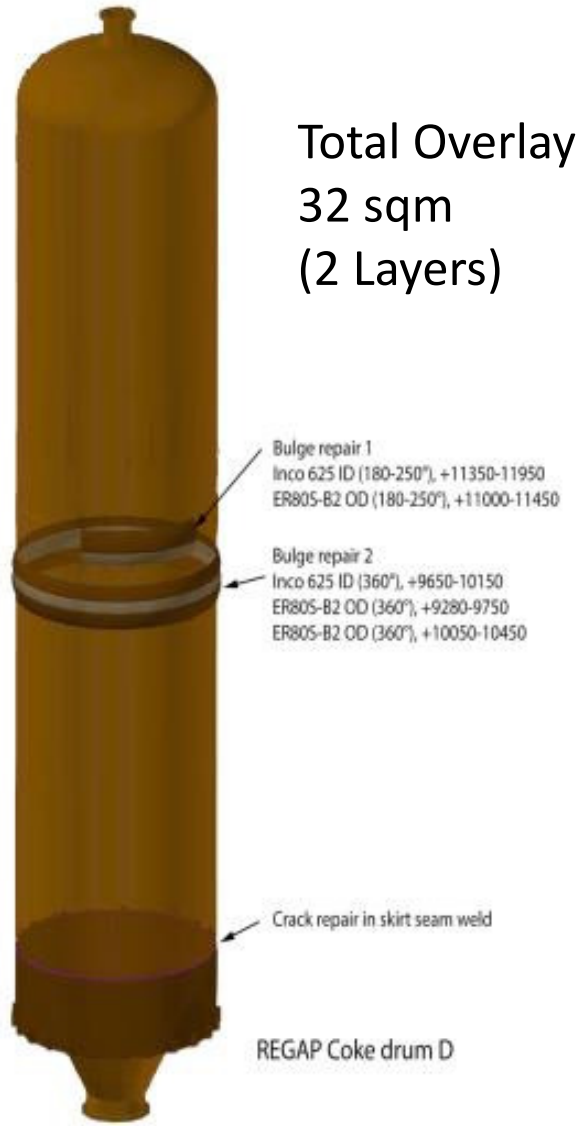


Typical Model of Structural Overlay Design

Overlay Designs for REGAP Cokers C & D

Total Overlay Size
28 sqm
(2 Layers)

REGAP Coke drum C



Total Overlay Size
32 sqm
(2 Layers)

REGAP Coke drum D

Both ID and OD Structural Overlays Installed in Vessels C&D

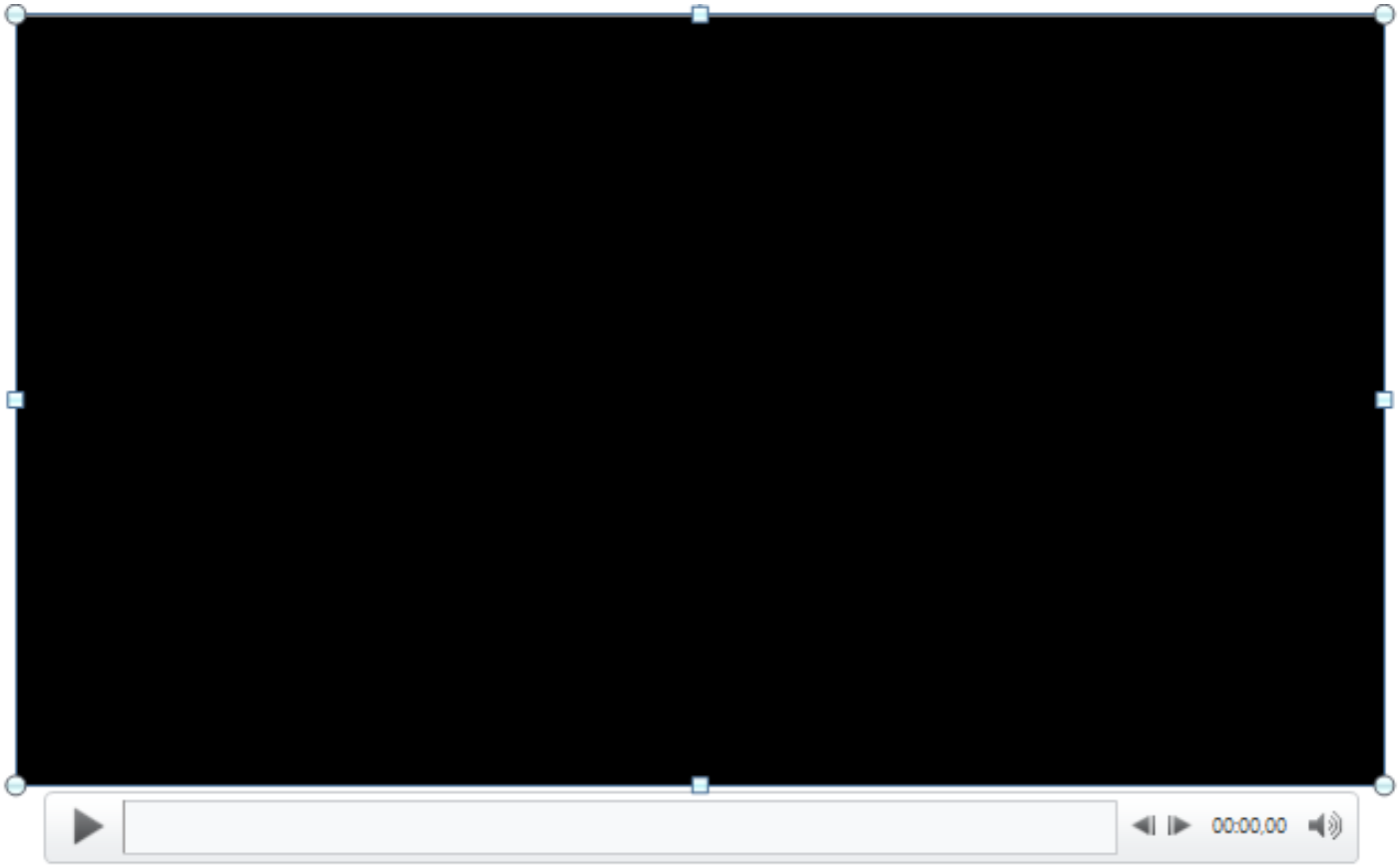
Internal overlays applied with NiCr Alloy 625

External Overlays applied with ER80S B2

Application of Strucrual Overlay on ID of The Vessel

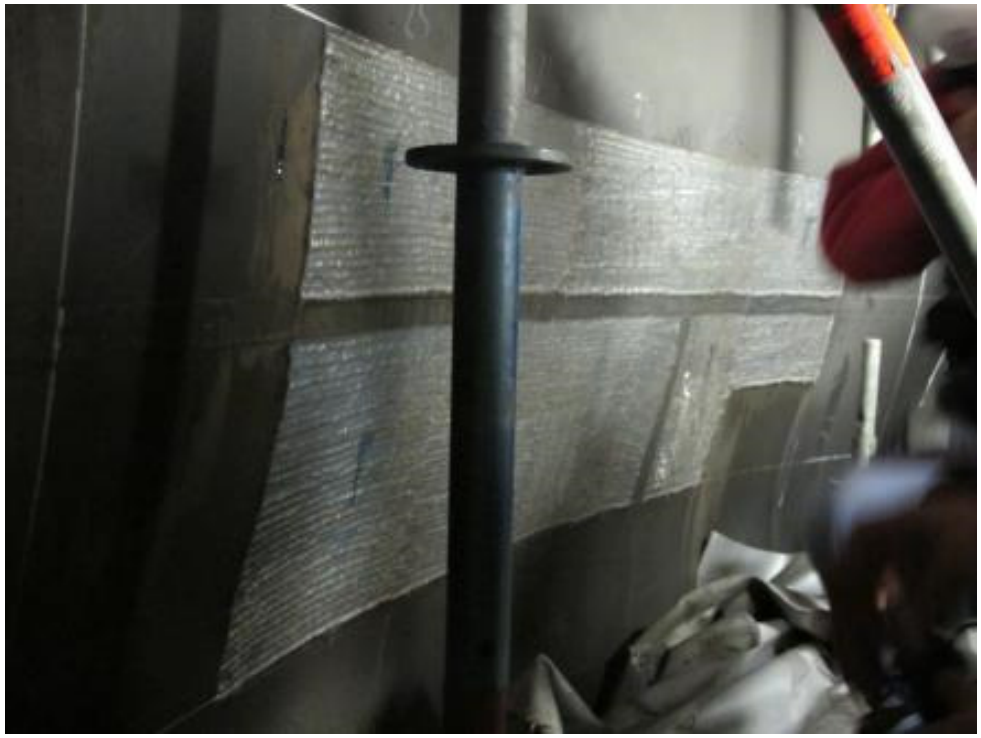
Fully Automated Weld Metal Overlay Welding Systems
Application of NiCr625 Alloy on the ID of the vessel

Application of Strucrual Overlay on ID of The Vessel



Fully Automated Weld Metal Overlay Welding Systems
Application of NiCr625 Alloy on the ID of the vessel

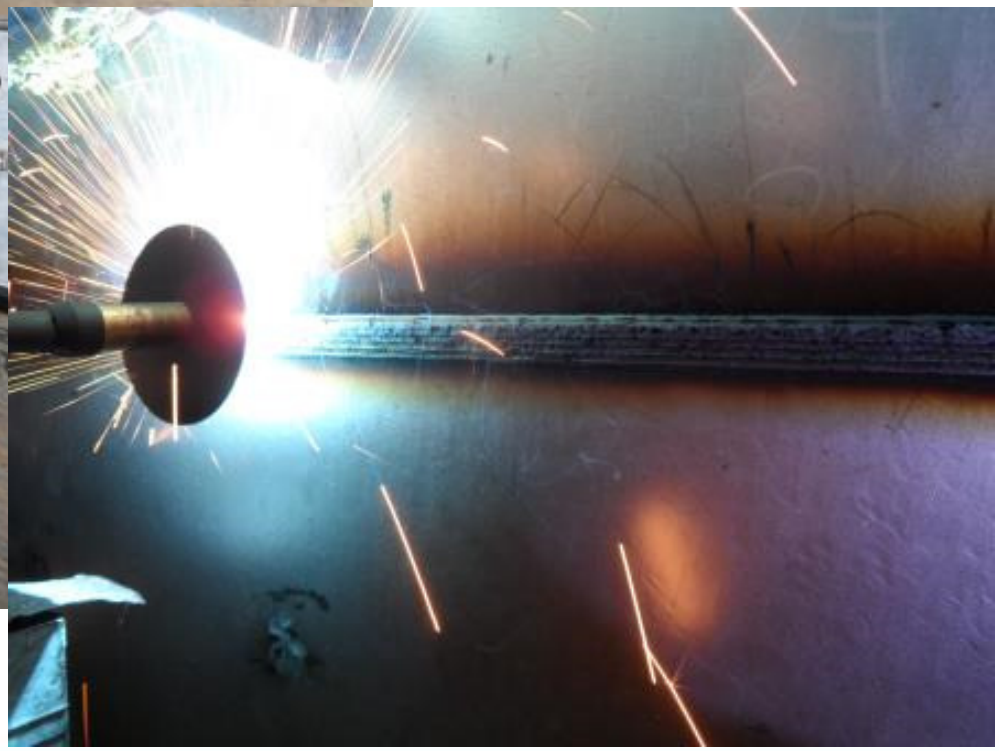
Removal of Cladding on ID of The Vessel



Existing Cladding Removed
Prior to Overlay Installation on the ID

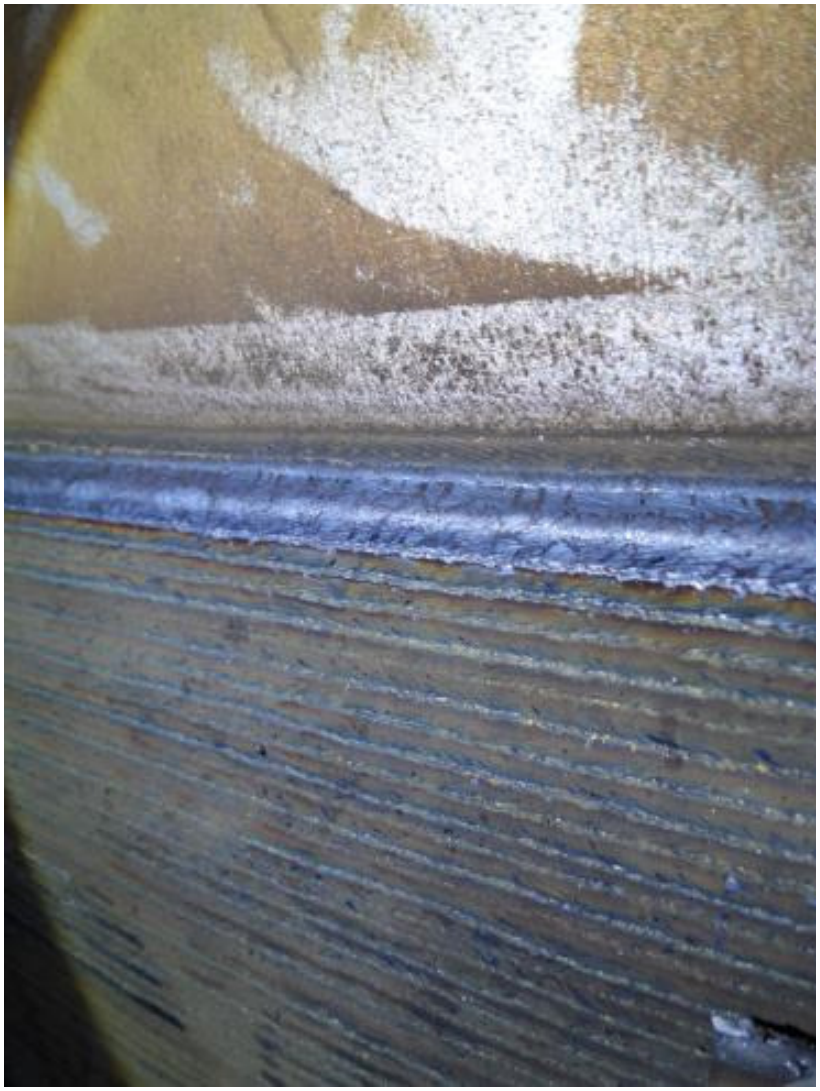
Skim Gouging Process
For Cladding Removal

Application of Strucrual Overlay on ID of The Vessel



OD Overlay

Application of Strucrual Overlay on ID of The Vessel

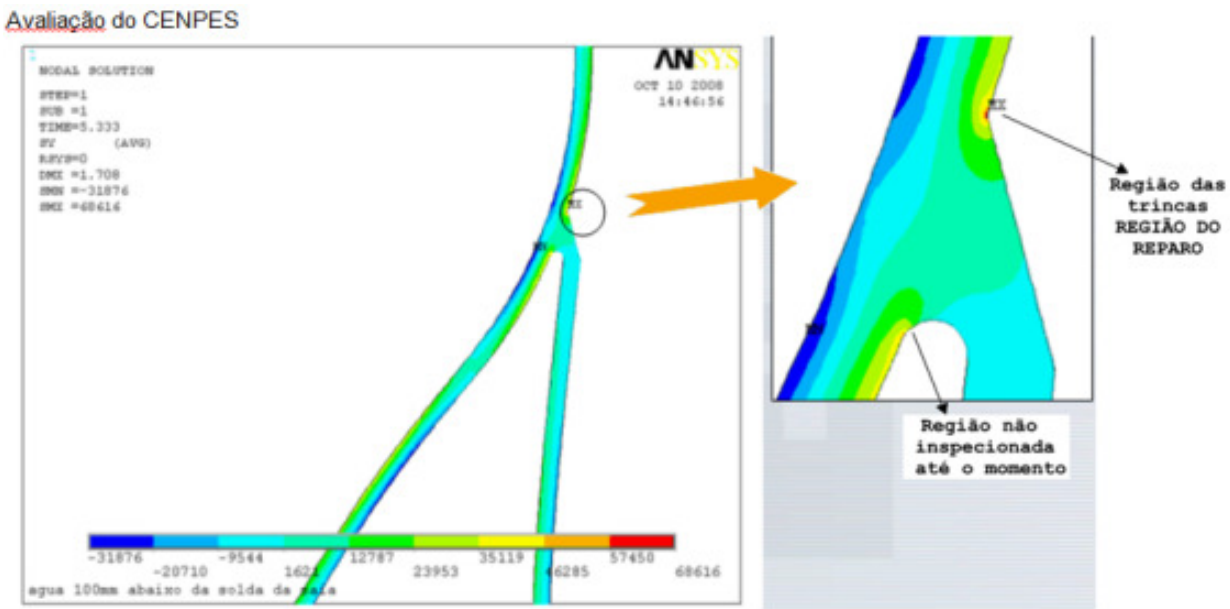


Close-Up of OD Overlay

Skirt Cracking Repair

In Vessels A,B,C&D Chronic Cracking has been experienced at the upper toe of the skirt to vessel weld

This cracking is caused by cyclic stresses driven by the expansion and contraction of the vessel inside the skirt

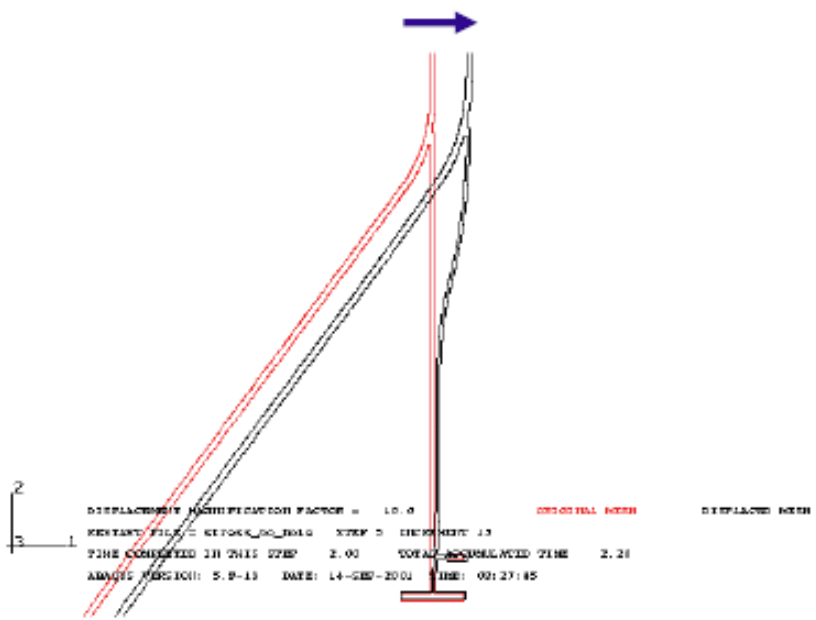


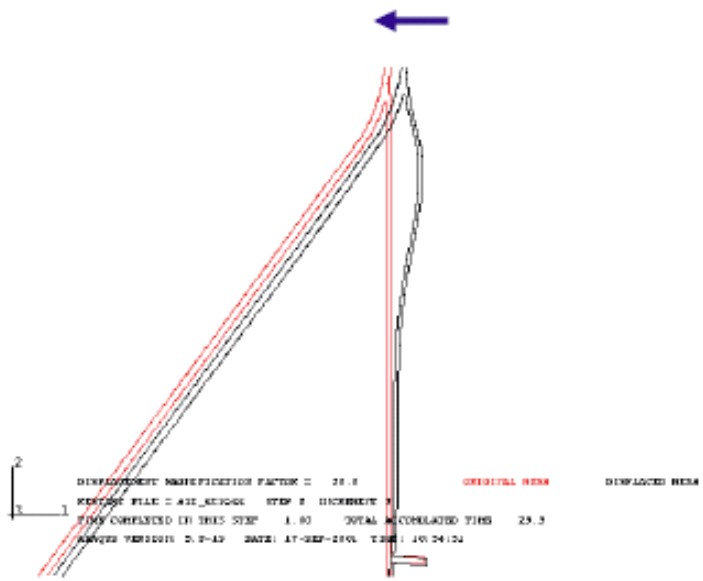
FEM Analysis of Failure Location

Photo of Cracking at the Skirt to Vessel Interface

During Quench - Skirt is Pushed and then gets Pulled by Knuckle

DISPLACED SHAPE AT THE END OF FILL





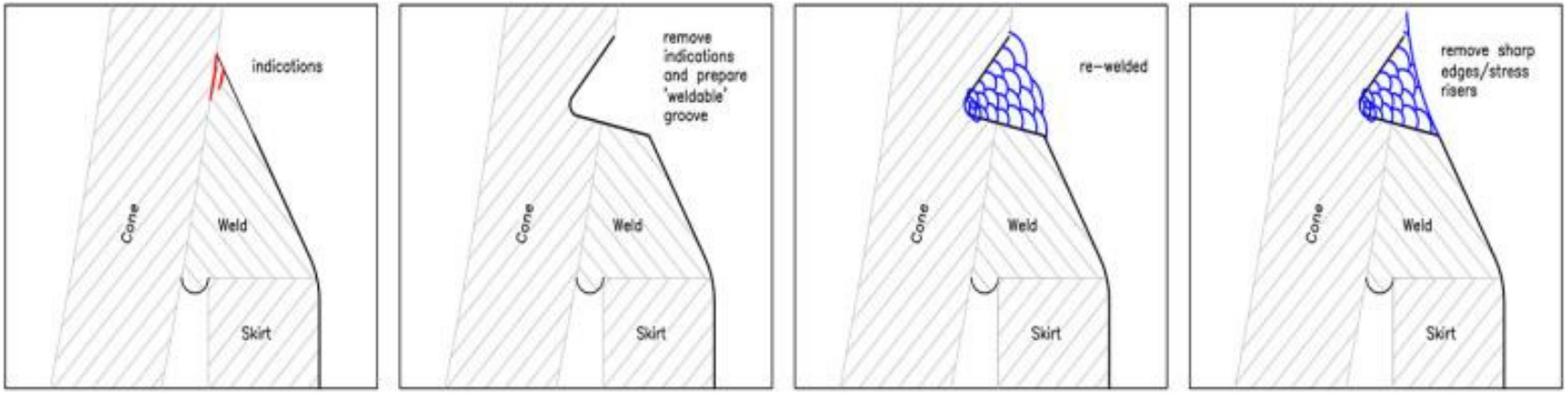
DISPLACED SHAPE 1 HOUR INTO QUENCH

(MAXIMUM STRESS DURING QUENCH OCCURS HERE)

**Courtesy of Stress Engineering*

Repair Process Selection

- Stick Welding (SMAW):
  - Previously performed using this conventional method
  - Re-Cracking Experienced
- Automated Welding :
  - Excavate area to remove previously installed repairs
  - Utilize Temper bead technique and automated welding process
  - Eliminate PWHT
  - Re-Contour geometry to minimize stress concentrations



Skirt Cracking Repair

Automated Welding Application

As-Welded Deposit

Finished Contour of Affected Area

Project Outcome

Safety

Project completed without any recordable safety incidents

Schedule

Original planned schedule 13 days.

Project completed in 16 days.

Advanced automated welding processes utilized to significantly shorten the overall project implementation schedule while achieving a better repair over conventional technologies used in the past.

Contact Information

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