



REFCOMM[®]
MUMBAI 2019


Reliance
Industries Limited



Reliance Industries *Growth is Life*

On Line Repair of DCU Vessel Skirt Cracks at Reliance SEZ Plant

Anand C Haridas –Head Corrosion & Inspection-Jamnagar Complex, RIL

Pedro E. Amador – VP Business Development & Technology, AZZ WSI

Disclaimer

Any statement, opinion, prediction, comment, or observation made in this presentation/publication are those of the presenter/author only and in no condition should be construed necessarily representing the policy and intent of Reliance Industries Ltd. (RIL).

The information presented herein are of the presenter/author's own and in no way RIL attracts any liability for any inconsistency or irregularity in terms of the accuracy completeness, veracity, or truth of the content of the presentation/publication. In addition, RIL shall not be liable for any copyright infringement and misrepresentation for the presented content as the content is presumed in good faith to be a creation of presenter's/author's own mind.

The scope of this presentation/publication is strictly for knowledge sharing purposes and not necessarily to provide any advice or recommendation to the audience/readers. Any endorsement, recommendation, suggestion, or advice made by the presenter/author shall be in his personal capacity and not in professional capacity as an employee of RIL. Any person acting on such endorsement, recommendation, suggestion, or advice will himself/herself be responsible for any injury/damage.



Introduction & Financials

A market leader across energy and materials value chain (E&P, R&M, Petchem) and in consumer businesses (Digital Services and Retail)

- Most profitable company for the year 2018-19. Recorded a net income of US\$ 5.7 billion
- Revenue of US\$ 90.1 billion, PBDIT of US\$ 13.4 billion. Market cap of ~\$ 125 billion

Energy Value Chain

Refining and Marketing



- Largest, most complex single site refinery with 1.24 mb/d capacity
- Consistently outperforming regional margins
- ~58% volumes placed in international markets

Petrochemicals



- Ranked Top 10 globally in key products
- 2nd largest producer of polyester fibre/yarn globally
- FY19 Production: 37.7 MMT

Exploration and Production



- Significant expertise in deep-water operations
- Substantial exposure in US Shale
- R-Cluster first gas expected in 2H FY2021

Consumer-centric Businesses

Reliance Retail



- India's largest retailer by revenue (\$18.9 bn)
- 10,415 stores with 22 MM sq.ft. space
- Presence across 6,600+ cities
- One of the world's fastest store expansion – added ~10 stores a day in last 2 years

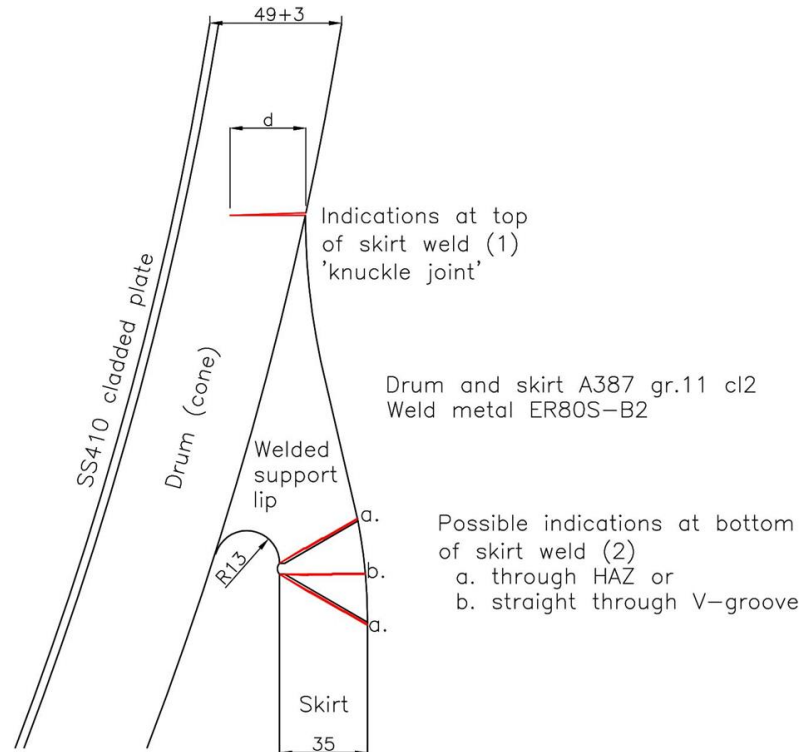
Reliance Jio



- All IP-data network with latest 4G LTE technology
- India's largest wireless data subscriber base : 306.7 Mn with net adds of 120 Mn in FY19
- ~10.9 GB per user per month
- Carrying 71% of the total industry's 4G data traffic (CY18)

Forty Years of Phenomenal Growth





- Classic skirt attachment failure locations.
- Blend Geometry of upper knuckle to vessel not smooth.
- Multiple conventional repairs at the SC1 location.

Phase 1 (Scope Performed During 2 Week Turnaround Window)

- Pre-Turnaround model knuckle transition geometry to generate a desired transition contour.
- Excavate and Repair knuckle joint cracking using an automated welding temperbead process.
- Using an automated overlay and template grinding process modify the transition contour of this area to meet the requirements of the designed geometry.

Phase 2 (Scope Performed with Units On-Line)

- Repair skirt cracks with a high quality weld deposit while the drums are online to minimize production loss.

Repairs Performed on 8 Drums in Parallel

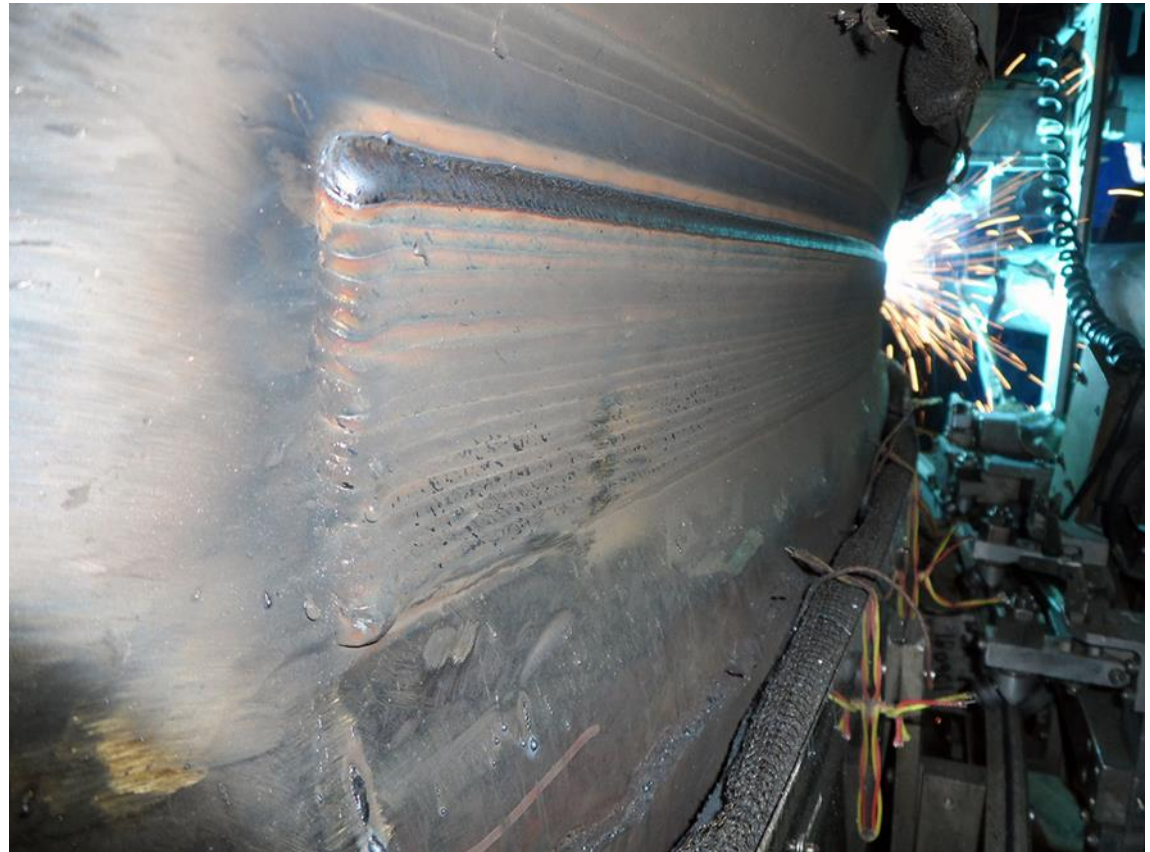
- Penetrant Inspection shows cracking at the top of the knuckle to vessel transition.
- Cracking ranged between 9mm to 25mm in depth.
- One location 35mm deep required ID/OD repair.
- Cracking was excavated until a clear PT was obtained.



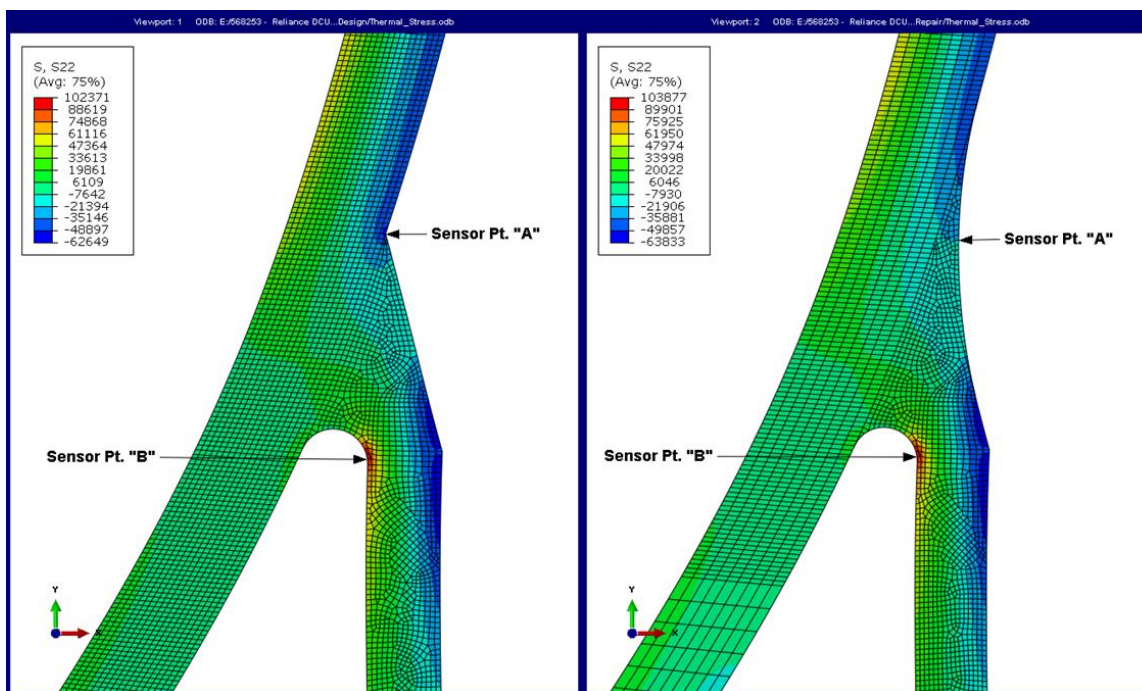
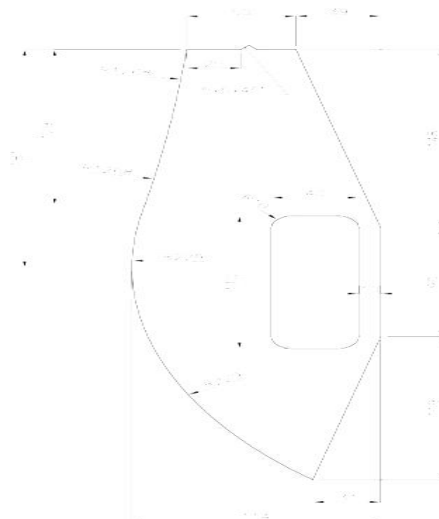
- Automated temperbead welding was used to re-weld the excavated areas. This deposit was then contoured to remove the last layer and to blend into existing geometry.



- Additional weld metal was then applied to add material for template grinding operation to obtain improved transition geometry.

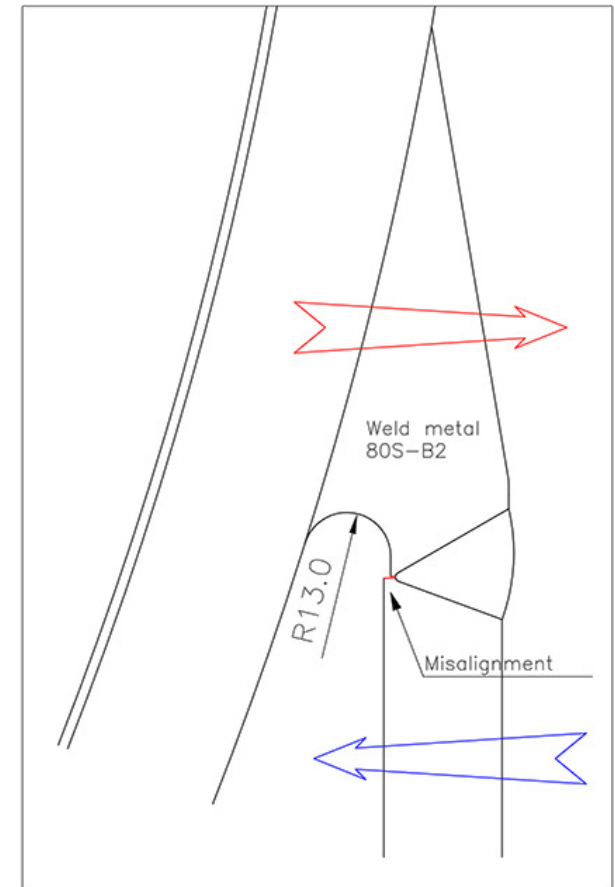
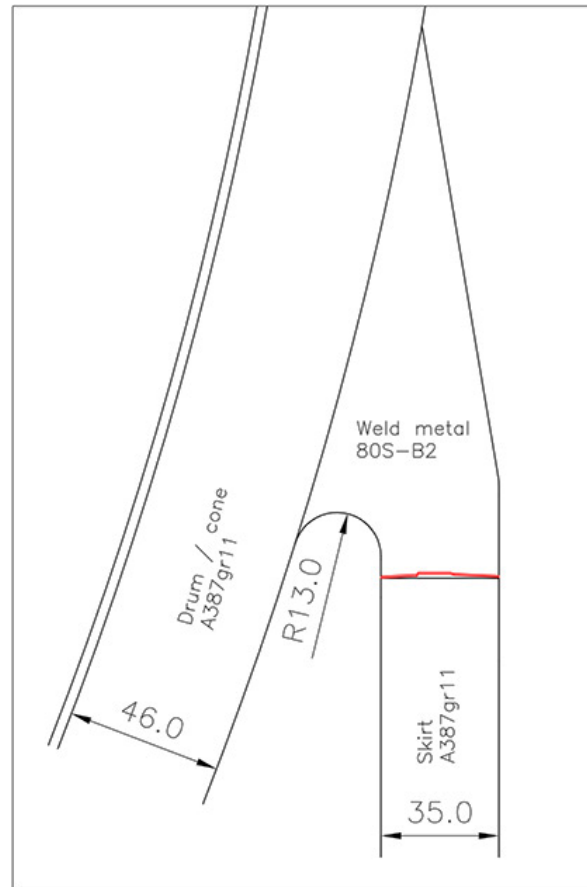


- Surface Contour after template grinding.
- Model of transitions area

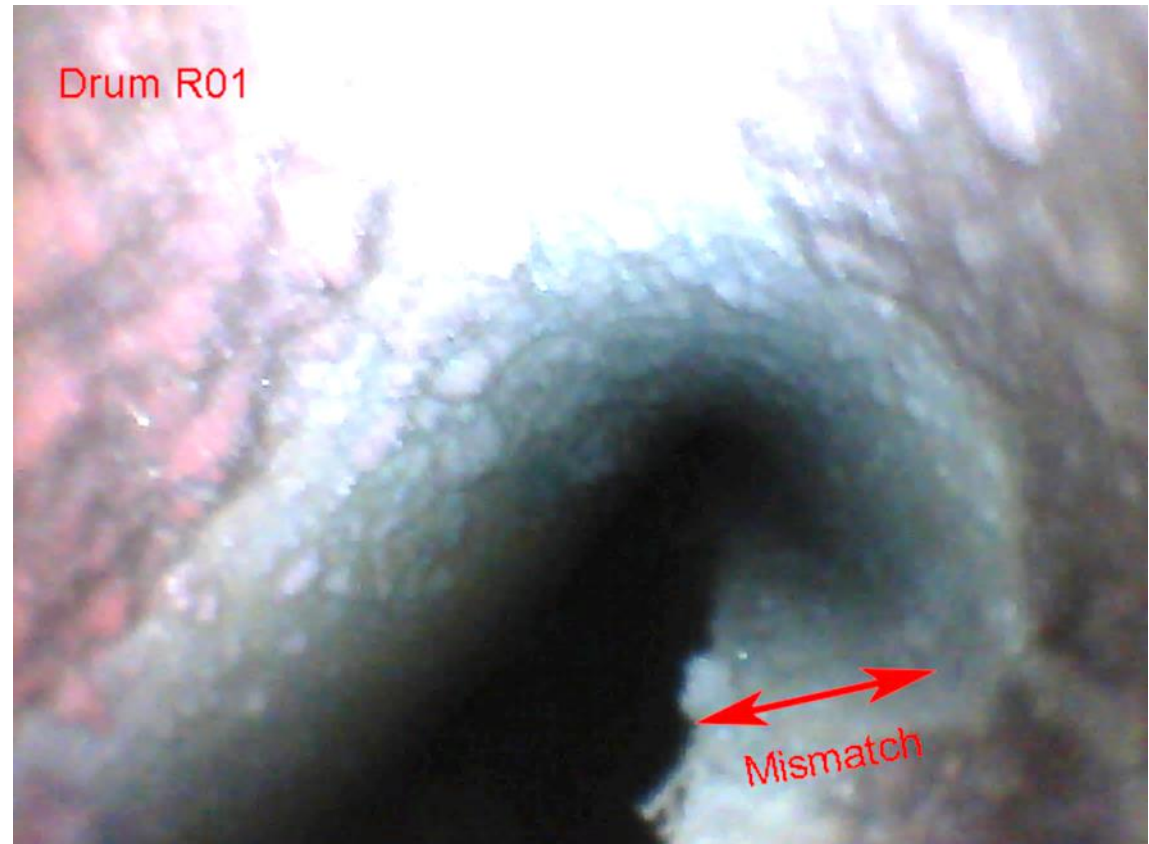


- Initial cracking in this area was experienced after 3 years in operation.
- Over time, several manual repairs were performed using conventional welding methods. Failure frequency of these repairs eventually necessitated a longer life solution.
- The extent of damage in this area was less predictable and presented a larger risk to overall schedule.
- A decision was made to develop procedures to allow the repairs to be performed with the vessels on-line during available safety windows.
- Although the existing damage was significantly more extensive than the original plan, this decision was successful.

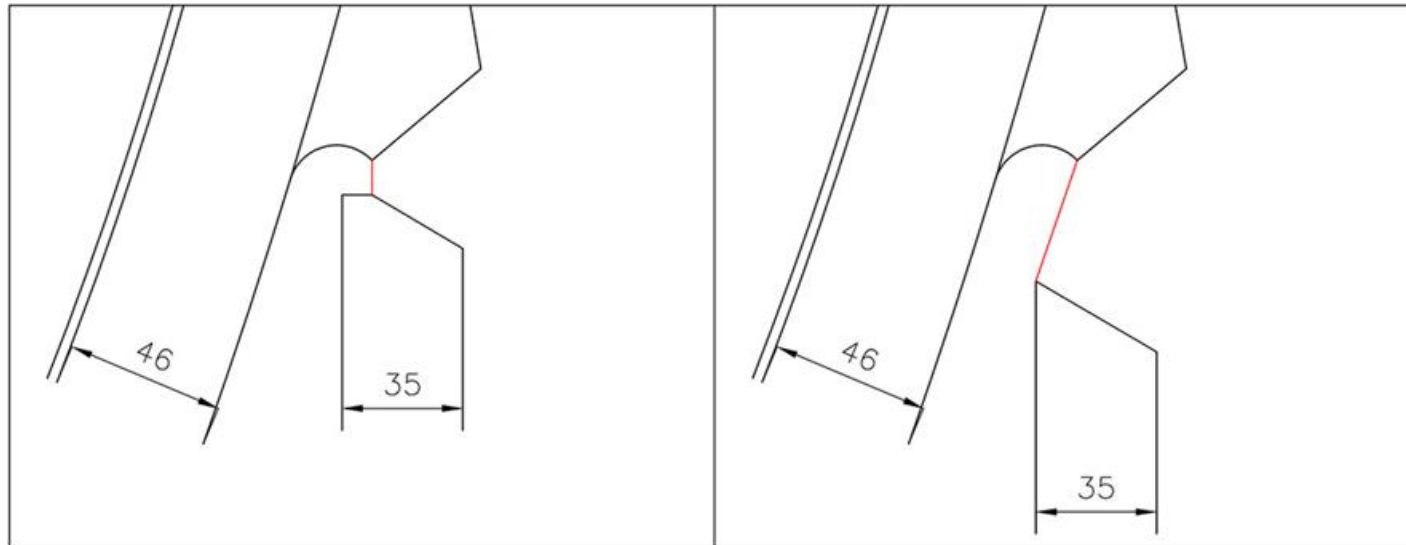
- Multiple repairs were made to this weld as needed to continue operation.
- Over time, the skirt and the knuckle became increasingly misaligned.
- This misalignment resulted in a decrease in size of the repair welds and created a location for future crack incubation.



- In some cases the mismatch was large enough to allow the skirt to almost touch the cone.



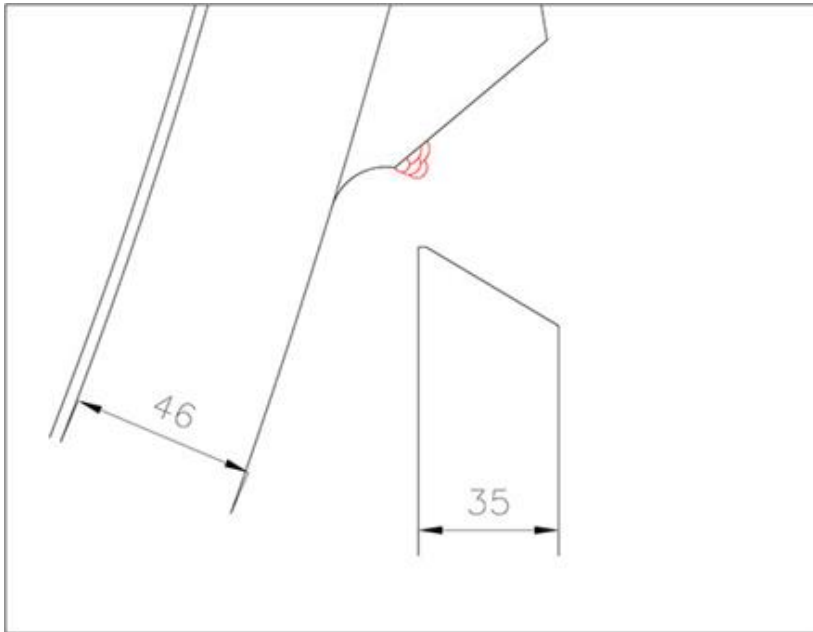
- The initial plan was to removed the damage metal and reinstall a weld that provided acceptable root geometry.
- The severe misalignment required that the width of the root opening be increased significantly to allow a proper geometry after welding.



Initial Excavation

Extended Excavation

- Weld build-up was used to reconstruct the excavated weld bevels prior to installation of the root pass.

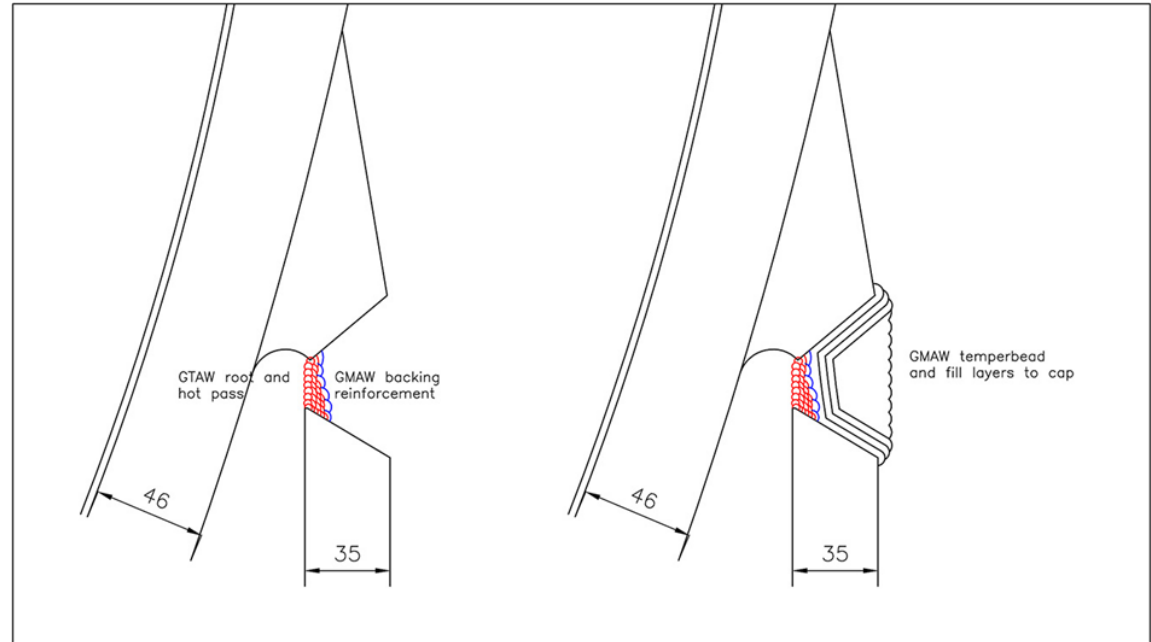


Bevel Reconstruction

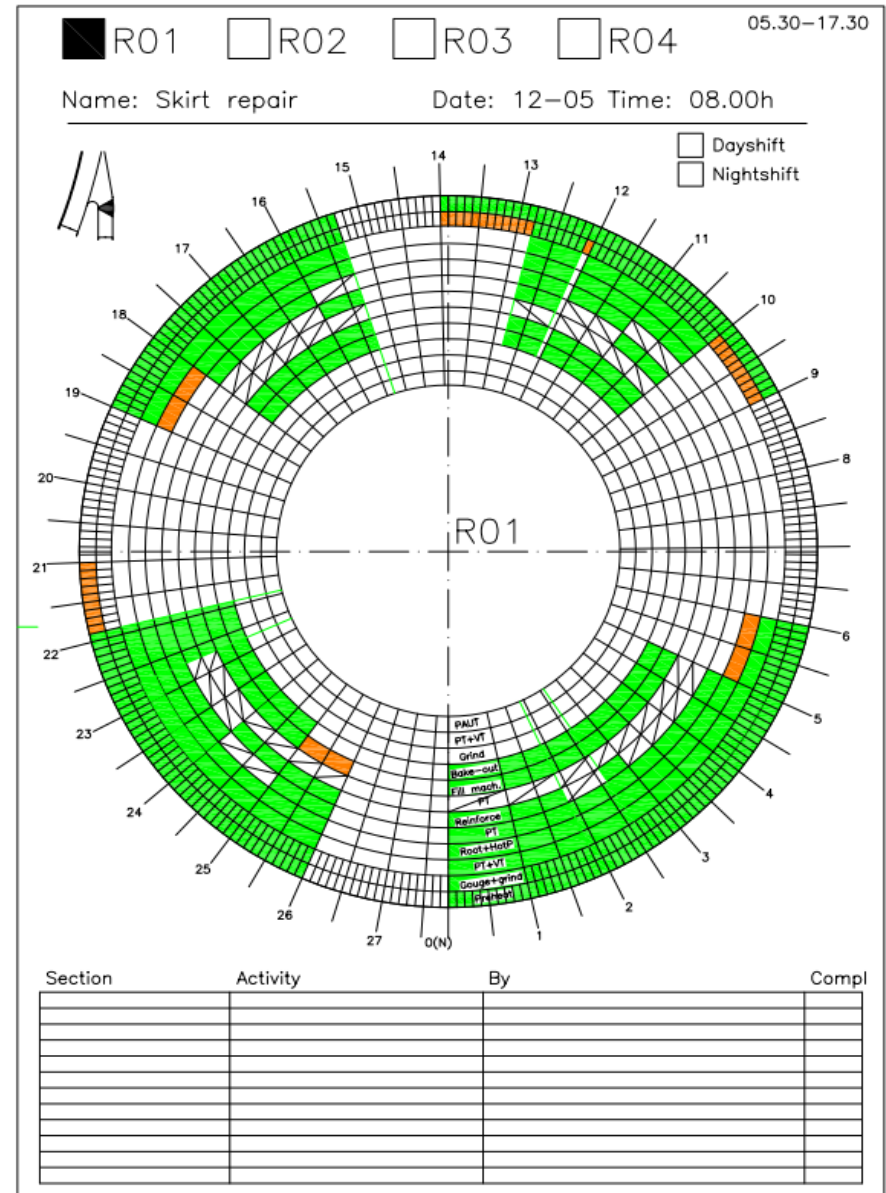


Reconstructed Bevel Ready for Root Pass

- After root reconstruction, automated temperbead welding was used to fill and cap the groove.
- Because these repairs were performed on an operating unit, the repairs had to be timed so that enough weld metal was applied during the work window to prevent cracking during the operating cycle.



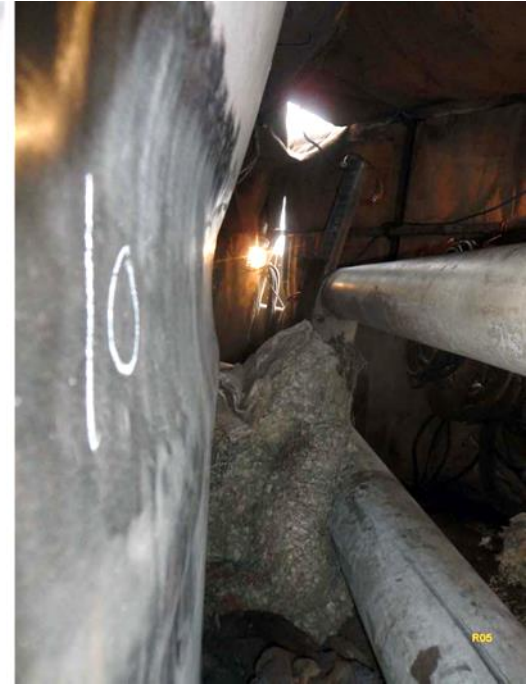
- Because 8 drums were being repaired in parallel using a temperbead process, careful tracking and monitoring of the status of each drum was required.
- Since repairs were made in operation, each team had to be ready to start work efficiently at the beginning of their work window.
- Effective communication and cooperation between Reliance and AZZ crews was likely the most important contribution to success.



- PAUT was used to inspect all welding upon completion.
- An average of 6 repairs were identified in each circumference with a maximum of 12 repairs on one of the vessels.



- Final Repair area with dye penetrant developer.
- Typical contour and surface finish for each drum.



- The largest on-line skirt repair was completed with minimal impact to unit production and excellent safety performance.
- Automated temperbead welding was used to perform the majority of welding with excellent PAUT results.
- The knuckle geometry was modified to reduce stress concentration and increase operating life.
- The complexity of working on 8 drums in parallel was managed using update and communication tools.
- Cooperation between Reliance unit personnel and AZZ provided an atmosphere for success.

Thanks for your attention

