PERFORMANCE OF WELD OVERLAY REPAIRED COKE DRUMS

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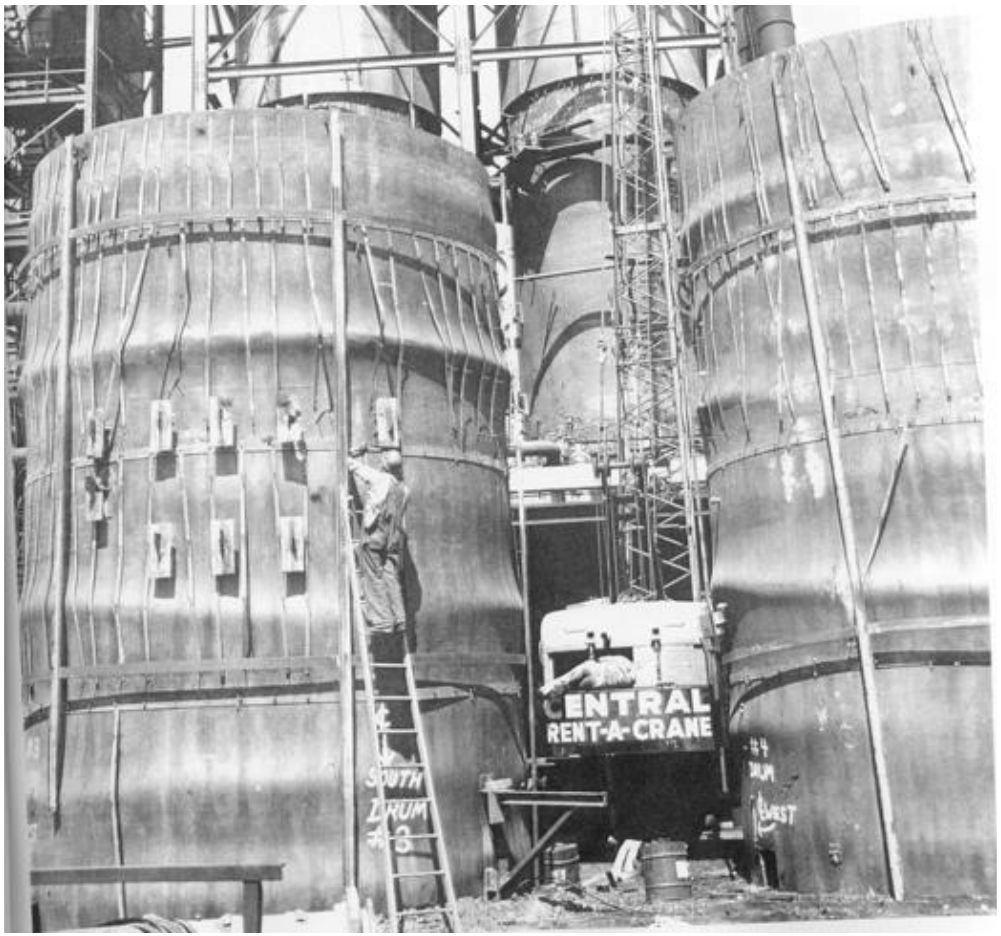
Shell Bulging

- Known problem for decades.
- Can lead to cracks and leaks
- Cause for drum replacement



Courtesy of CB&I

Bulge Repairs

- Classic repairs
- Automated weld overlay repairs
  - Industry experience
  - Lack of bulge performance data

Scope

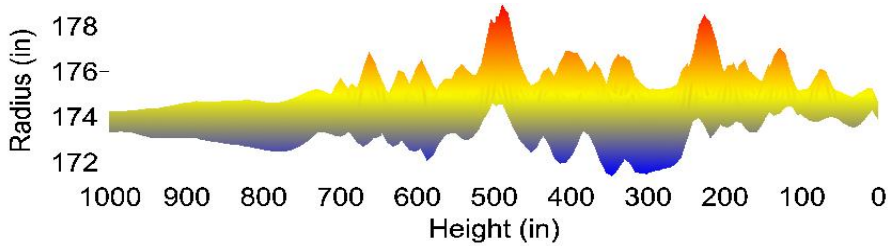
- Performance obtained from the following procedure:
  - Internal 2D laser scanning.
  - Bulging assessment and development of repair plan based on Plastic Strain Index (PSI)™.
  - Weld overlay enforcement that employs a GMAW process with automated controlled-deposition temper-bead welding.
- Limitations:
  - Above methods are not unique and have advantages and disadvantages.
  - Performance is highly dependent on underlying technologies.
  - Performance may not be identical to experience of other operators.

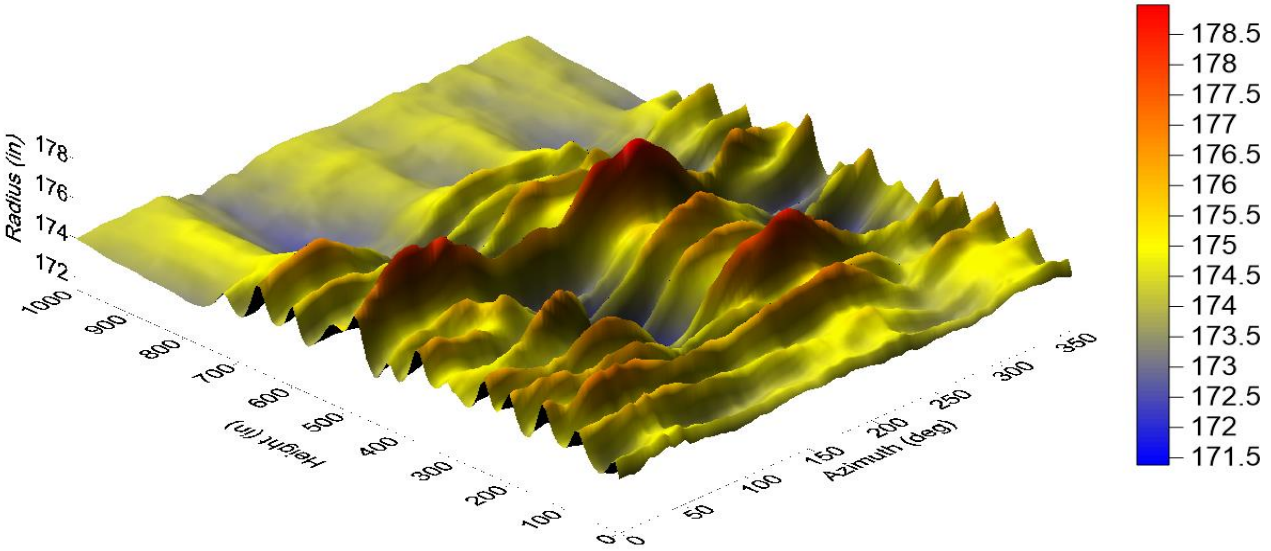
Equipment Description

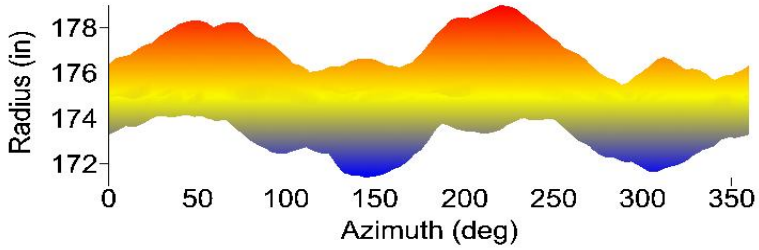
- Eight 18 year old coke drums
- 29 feet in diameter
- Variable shell thickness between 1 and 1.5 inches.
- Shell: 1 ¼ Cr - ½ Mo base metal with stainless steel clad.
- Operated at 48-28 hours total cycle time
- High-quality fabrication

Bulging

Developed severe bulges after seven years in service.

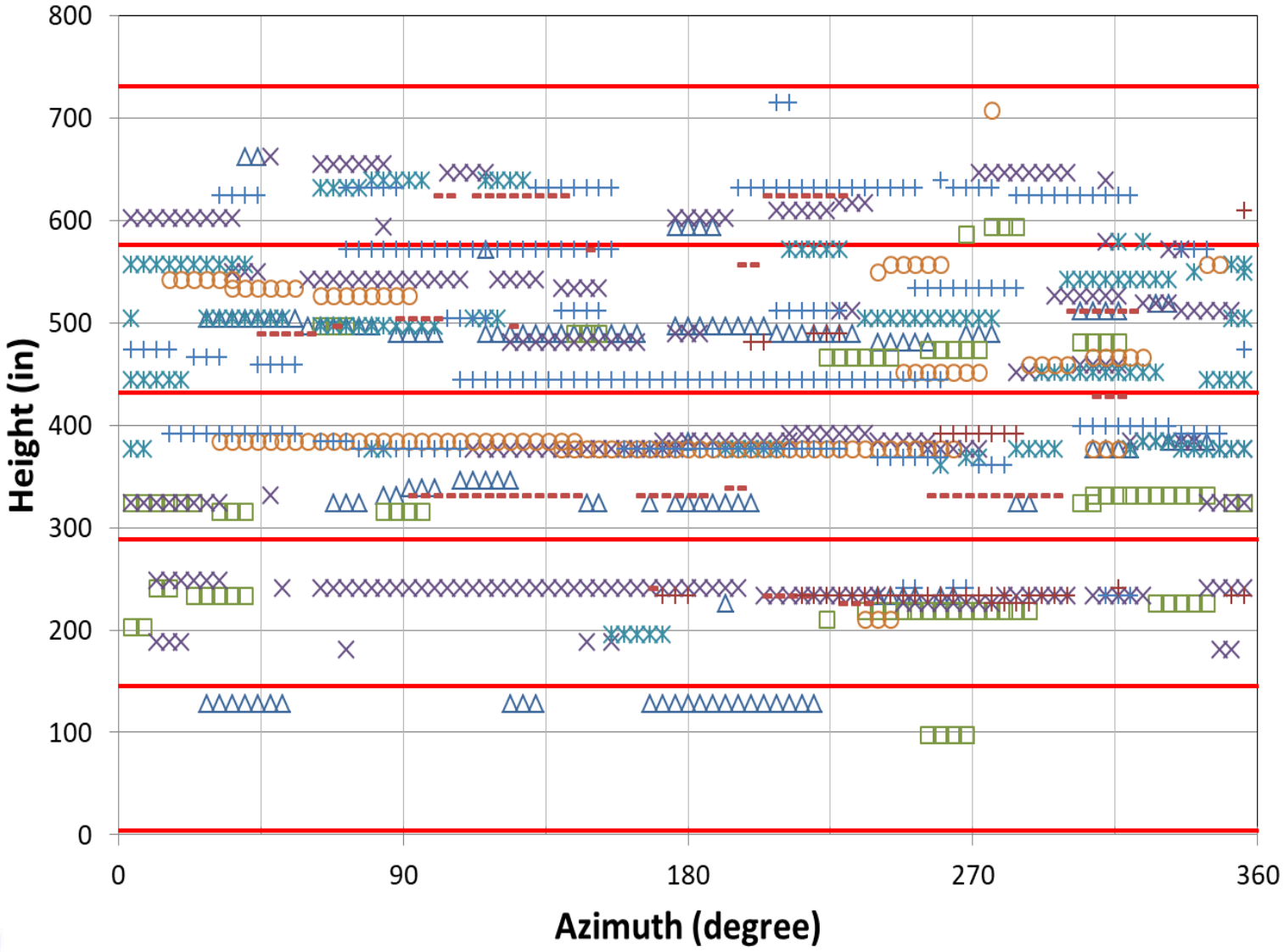






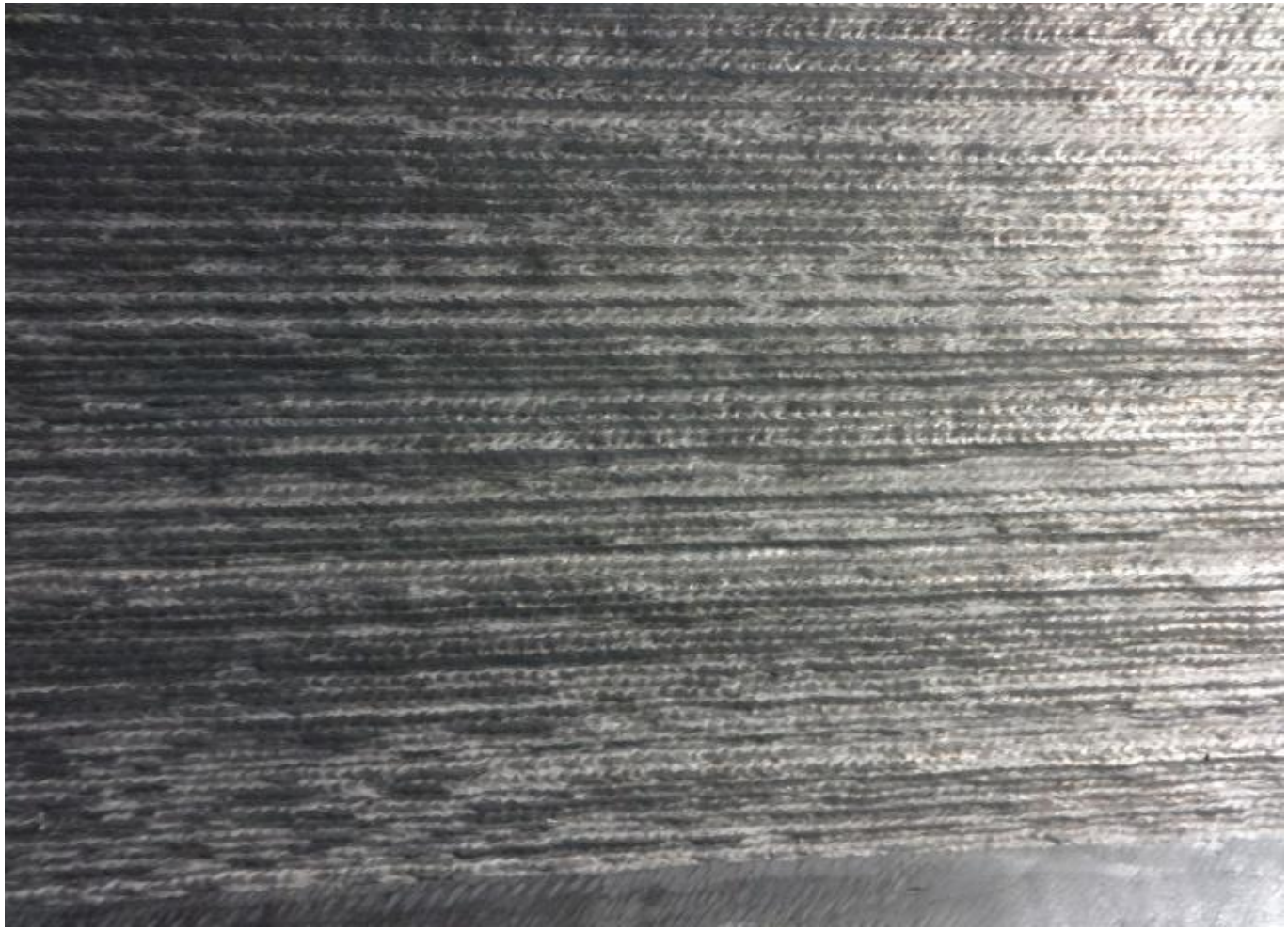
Severe Bulge Indications

(Locations of PSI exceeding "Design" level in all drums)



Bulge Repairs

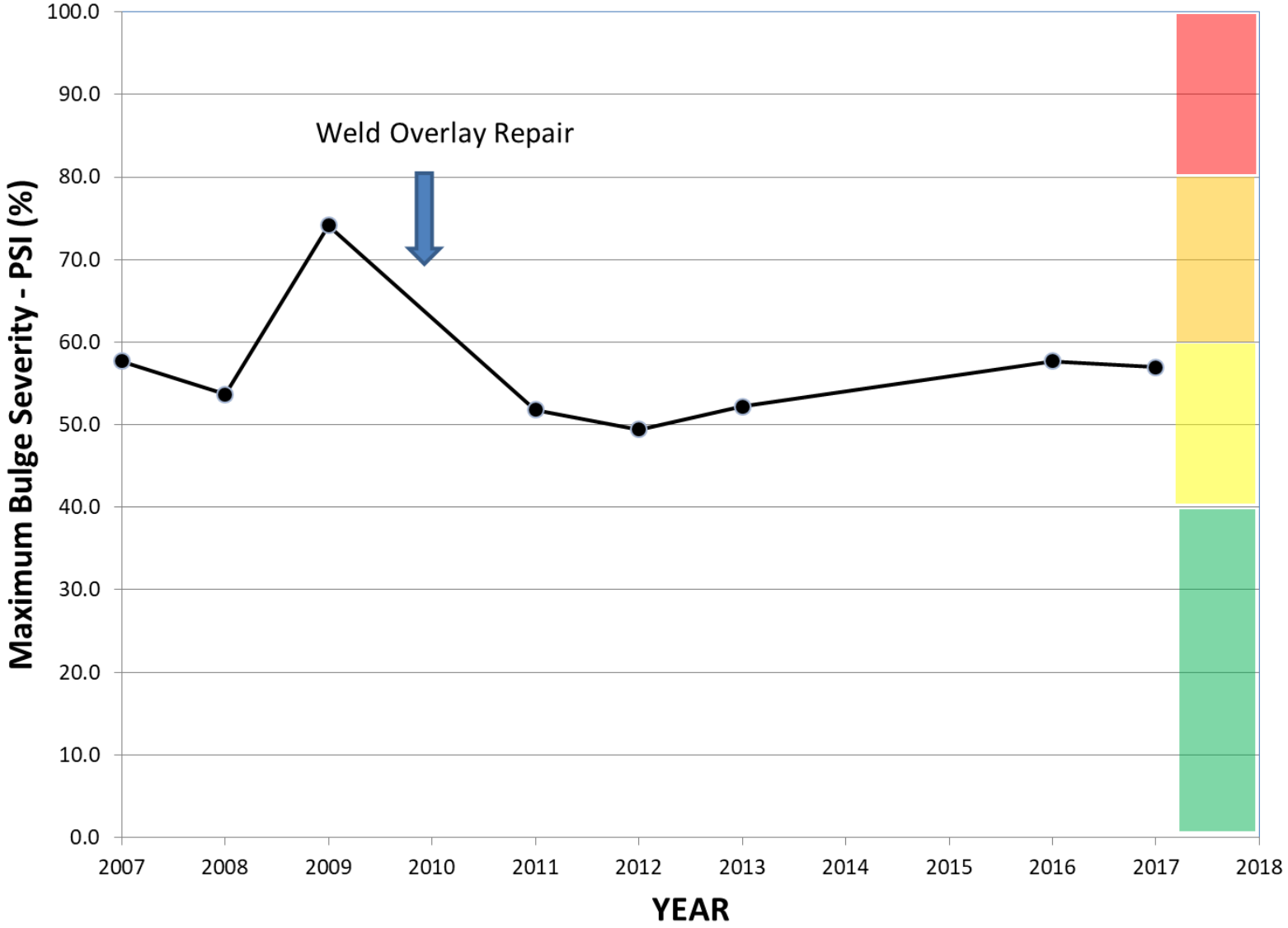
Several drums repaired using automated weld overlay in stages starting after ten years in service.



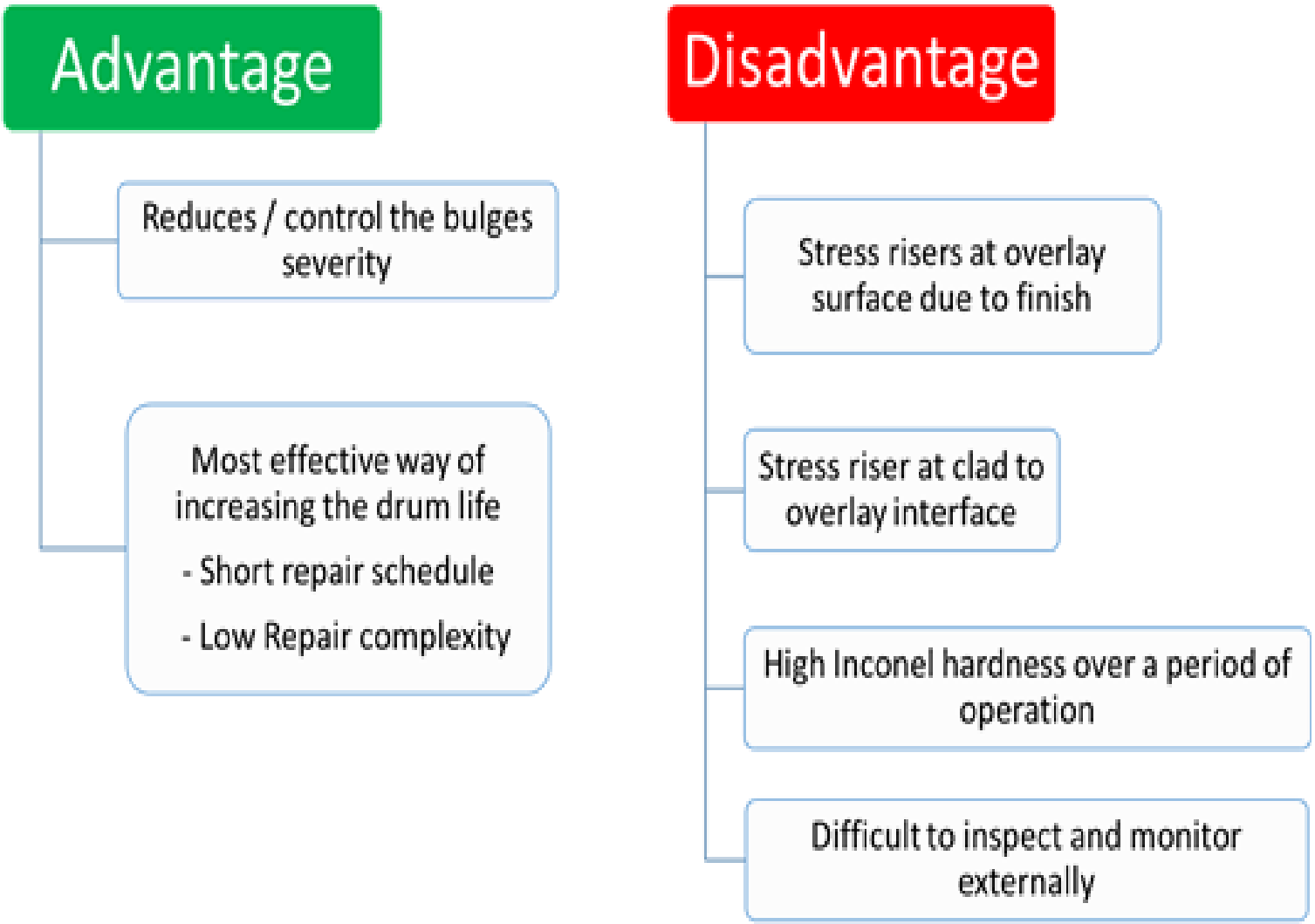
Before-After Comparison

		Maximum Plastic Strain Index PSI (%)			
Drum Set	**Drum**	**Before Repairs**	**After Repairs**	**Change**	**Average**
Severe bulges repaired using weld overlay	A	65.2	67.6	4%	-9%
	B	73.7	72.5	-2%	
	C	80.1	55.9	-30%	
	D	70.3	67.6	-4%	
	E	67.1	67.9	1%	
	F	74.2	57.0	-23%	
Not repaired	G	51.4	69.7	36%	21%
	H	51.2	54.1	6%	

Single Bulge Performance



Discussion


Advantage
Reduces / control the bulges severity
Most effective way of increasing the drum life
- Short repair schedule
- Low Repair complexity
Disadvantage
Stress risers at overlay surface due to finish
Stress riser at clad to overlay interface
High Inconel hardness over a period of operation
Difficult to inspect and monitor externally

Conclusions

- Repair process was successful in stabilizing severe bulges.
- Bulging severity continued to increase in unrepaired bulges. Repairs had no observed impact on bulging severity of unrepaired areas.
- Weld overlay reinforcements of circumferential seams have helped in reducing cracking tendency at these welds.
- With few exceptions, repaired areas have not cracked again despite remaining deformation and high plastic strain. The few uncharacteristic cracks that developed in repaired area were attributed to poor execution of weld perimeter or surface finish.
- This bulge scanning-assessment-repair process has helped in extending the life of this set of drums by a minimum of five years.