

A DIFFERENT APPROACH TO ARREST THROUGH WALL CRACKS ON A COKE DRUM USING WELD OVERLAY

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COKE DRUMS SPECIFICATIONS

Base Metal: SA-387 Gr. 11 Cl. 2

Clad: SA - 240 TP.410S

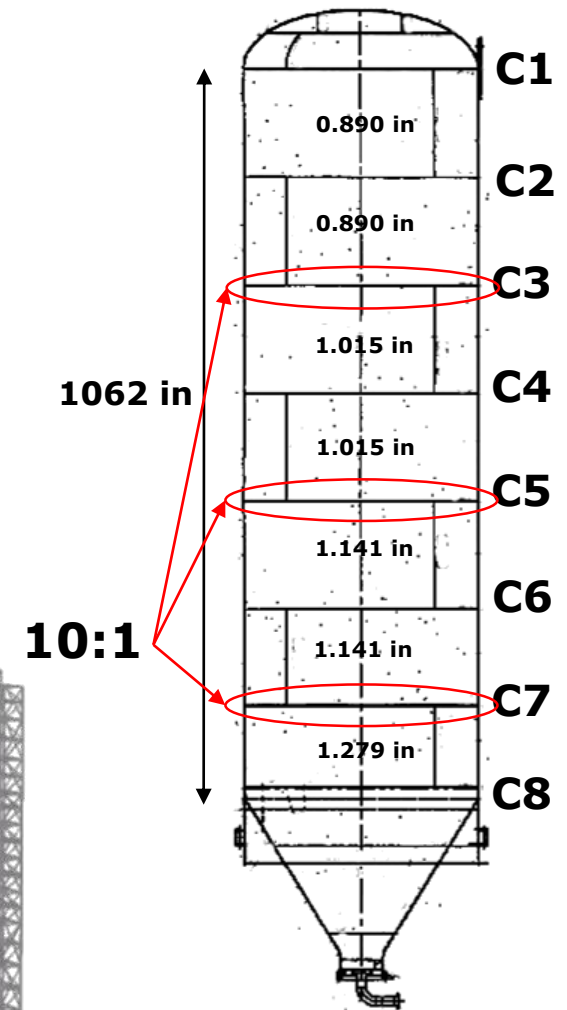
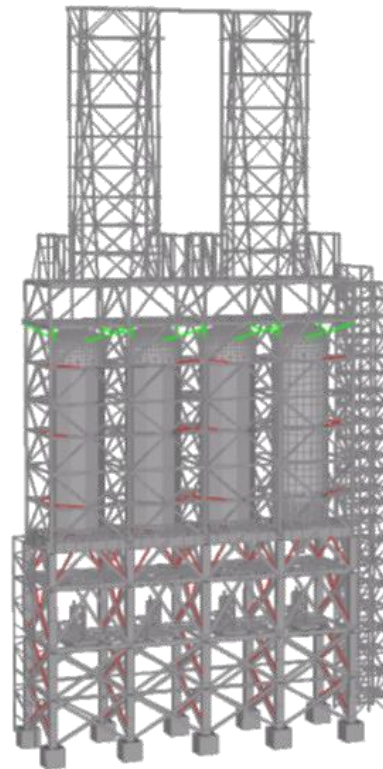
Coking: 95.0 psi → 50 psi (Top) @ 840°F

Quenching: 123 psi → 50 psi (Top) @ 300°F

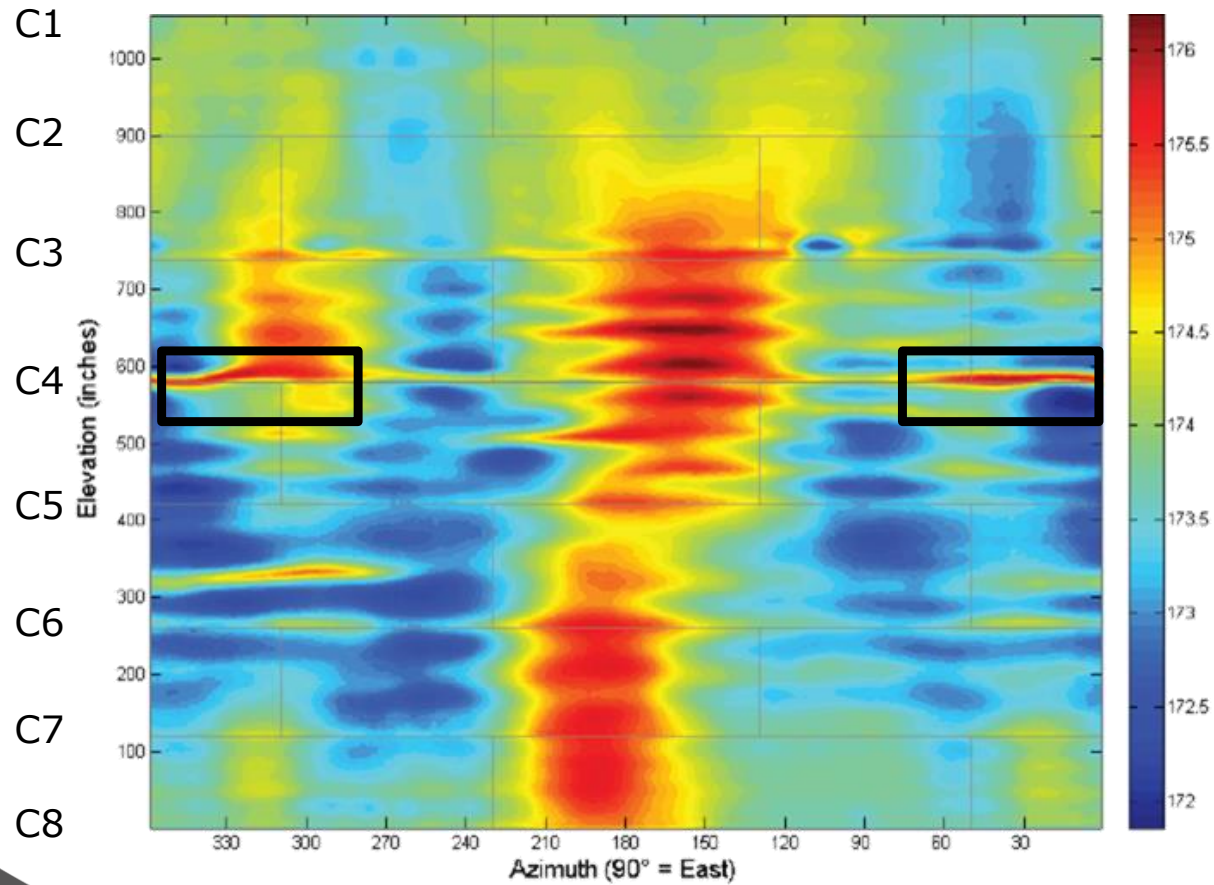
$r = 174$ in

Cladding Thickness: 0.11 in

**Central Feed
Manual Unheading System
Operating Since 2004**



COKE DRUM BACKGROUND



November 2015

CASE STUDY

$$\text{Bulge Severity Factor} = \frac{\sigma_{\text{Computed}}}{\sigma_{\text{Nominal}}}$$

November 2015

DRUM 1

Max BSF = 14.5

DRUM 2

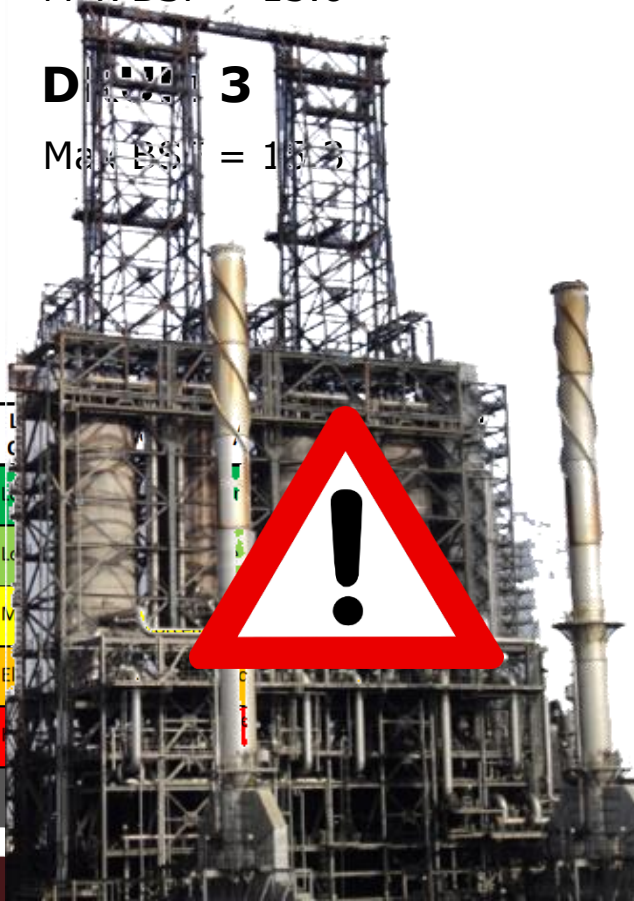
Max BSF = 13.6

DRUM 3

Max BSF = 15.3

DRUM 4

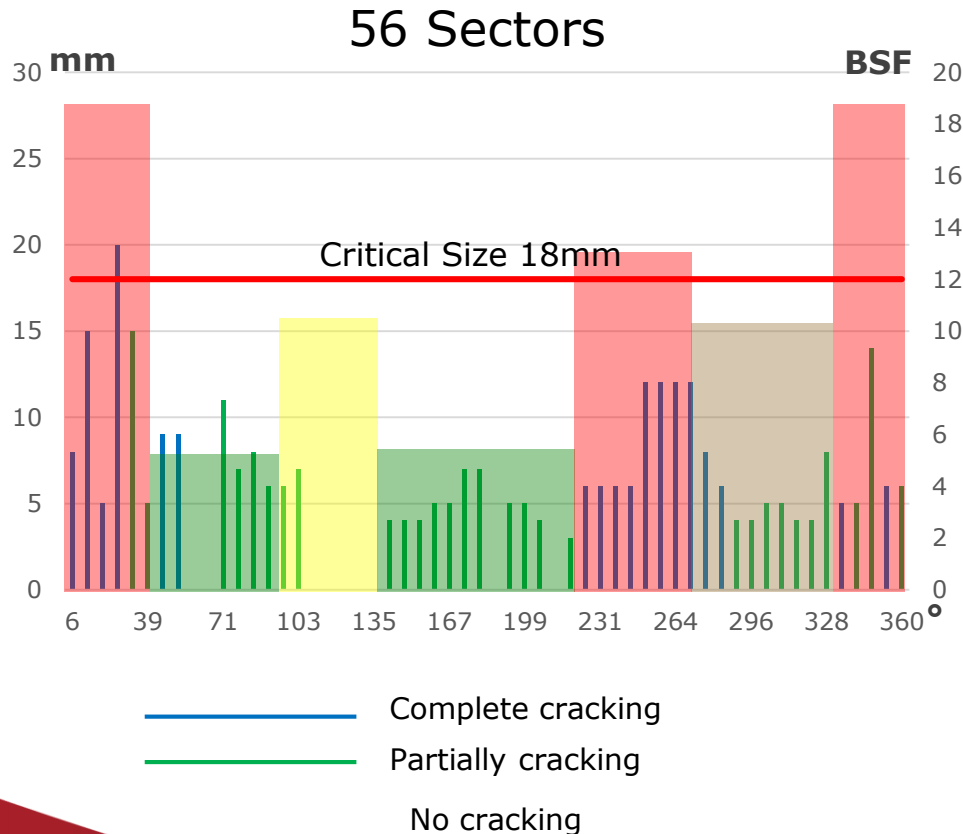
Location ID	Description	Angle (degrees) 90°=East	Elevation (inches) from Bottom Seam	Axial BSF Value	Width (deg)	Height (inches)	Nearest Circumferential Seam
OD1	Local OD Max	0	597.7	12.3	57	21	Seam C4 (580 in)
OD2	Local OD Max	11	566.2	11.8	27	30	Seam C4 (580 in)
OD3	Local OD Max	114	756.7	11.5	25	18	Seam C3 (739 in)
OD4	Local OD Max	242	600.7	10.8	40	25.5	Seam C4 (580 in)
OD5	Local OD Max	359	563.2	9.2	9	22.5	Seam C4 (580 in)
OD6	Local OD Max	251	566.2	8.6	38	25.5	Seam C4 (580 in)
OD7	Local OD Max	226	486.7	7.2	26	21	Seam C5 (420 in)
OD8	Local OD Max	99	564.7	6.3	33	15	Seam C4 (580 in)
OD9	Local OD Max	104	600.7	6.2	32	18	Seam C4 (580 in)
OD10	Local OD Max	237	240.7	6.2	28	27	Seam C6 (261 in)
OD11	Local OD Max	352	441.7	5.7	20	16.5	Seam C5 (420 in)
OD12	Local OD Max	250	759.7	5.7	20	12	Seam C3 (739 in)
OD13	Local OD Max	242	699.7	5.7	24	13.5	Seam C3 (739 in)
ID1	Local ID Max	0	581.2	19.2	65	16.5	Seam C4 (580 in)
ID2	Local ID Max	245	584.2	13.5	51	18	Seam C4 (580 in)
ID3	Local ID Max	223	506.2	8.3	33	15	Seam C4 (580 in)
ID4	Local ID Max	105	582.7	7.7	42	10.5	Seam C4 (580 in)
ID5	Local ID Max	235	264.7	6.5	35	10.5	Seam C6 (261 in)
ID6	Local ID Max	97	543.7	6.2	33	10.5	Seam C4 (580 in)
ID7	Local ID Max	118	746.2	6.1	11	16.5	Seam C3 (739 in)
ID8	Local ID Max	342	321.7	6.0	29	15	Seam C6 (261 in)
ID9	Local ID Max	251	744.7	5.9	32	6	Seam C3 (739 in)
ID10	Local ID Max	116	771.7	5.8	13	19.5	Seam C3 (739 in)
ID11	Local ID Max	97	771.7	5.3	9	12	Seam C3 (739 in)



CASE STUDY

UT Phased Array Inspection C4 Drum 4

June 2016



DRUM 2

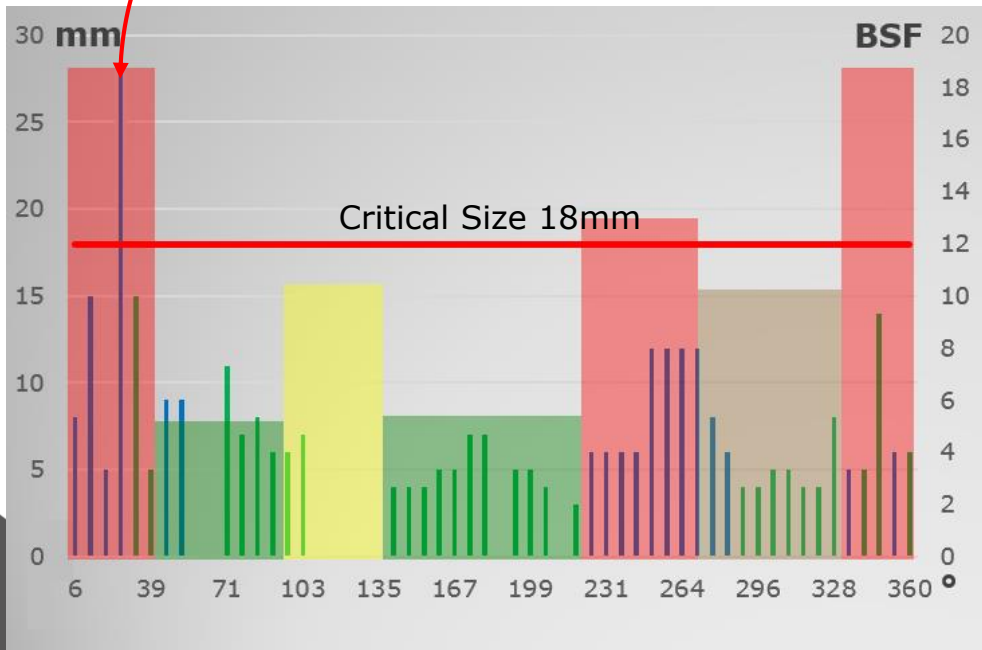


August 2016

CASE STUDY

UT Phased Array Re-Inspection C4 Drum 4

Lenght = 500 mm / 19.69 in
Depth = 27 mm / 1.06 in



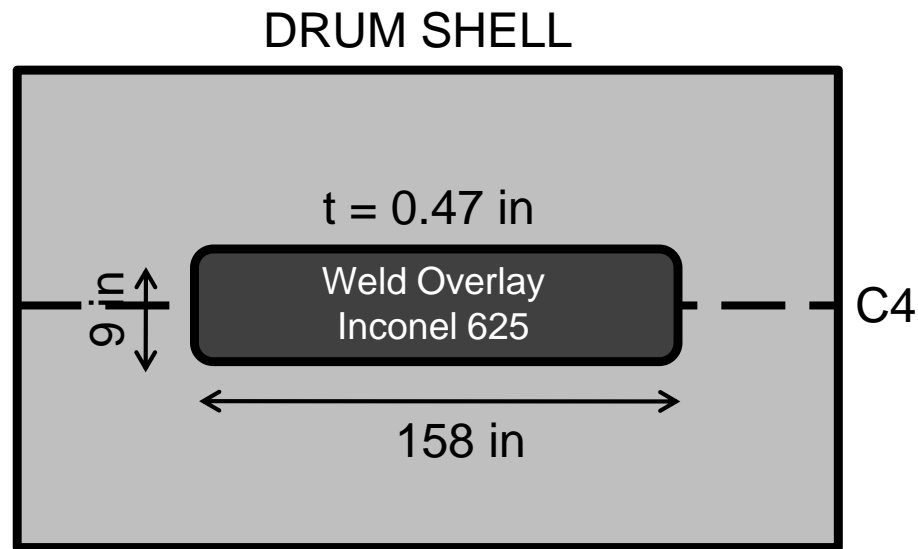
August 2016

Few days later after
Drum 's 2 Failure...

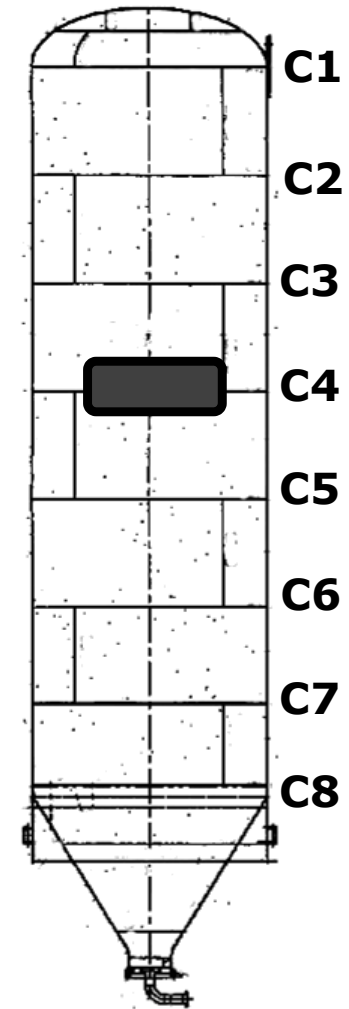
Remaining Thickness = 0.12 in



SHORT-TERM PLAN

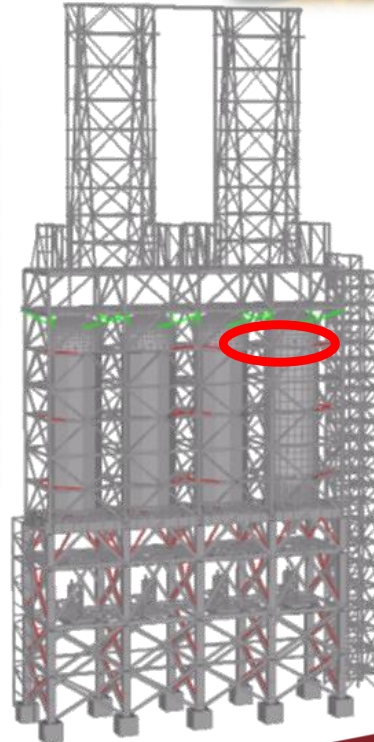


Will it work?



EXECUTION

- ✓ Semi Automatic Machines
- ✓ Certified Welders
- ✓ ERNiCrMo-3



**Scaffolding
attached to the
structure**

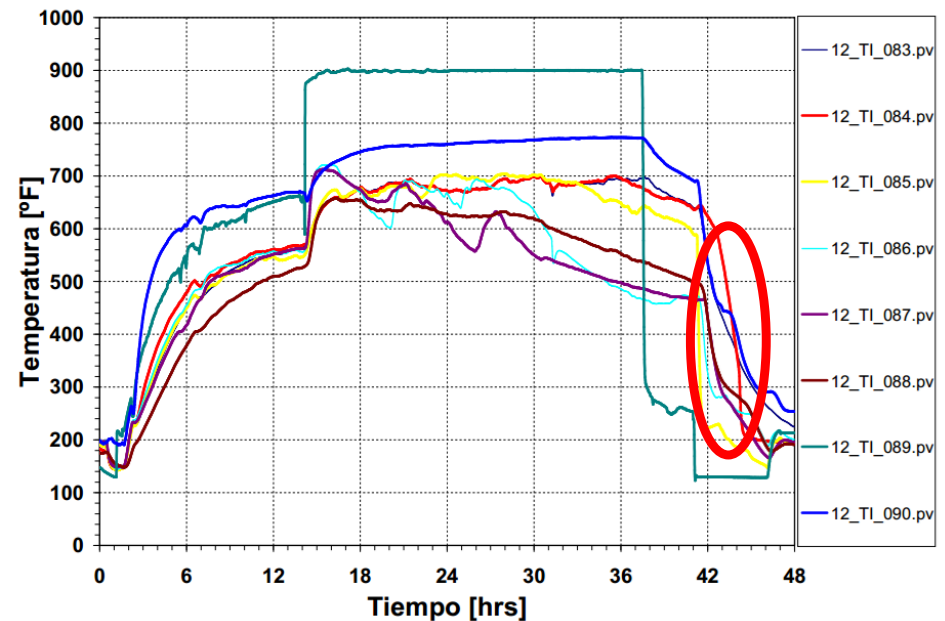
EXECUTION

Best Part



**The Upgrader did not
need to shutdown the
coke drum**

Step	Time(h)
Steam Preheat	5
Coking	24
Steam Stripping	4
Water Quenching	6
Drain	2
Flange Removal	1
Decoking	5
Rehead / Steam Purge / Test	1
Total Length Cycle	48



5h Welding per Quenching

DISCUSSION

- ✓ The repair took 1 week during operational windows.
- ✓ The crack was successfully arrested.
- ✓ It has been 13 months since the repair and the drum is still operating.
- ✓ We recommended UT inspection to the upgrader in order to evaluate the crack behavior.
- ✓ We recommend to repair the cracks the next turnaround and perform weld overlay reinforcement on the areas with high BSF.
- ✓ Although it was not a repair under code, the main objective was achieved and therefore we highly recommend this approach to arrest cracks.



SUCCESS

QUESTIONS?

REFCOMM[®]
BUDAPEST
2-5 Oct 2017

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