The Different Types and Causes of Coke Drum Bulging

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History of Shell Bulging

- Major problem for decades.
- Despite design improvements, still a problem- perhaps more severe today.



Courtesy of CB&I



Bulging Study Background

- Database of one hundred and eighty four laser scans from coke drums in North America, South America, Europe, and Asia:
 - Carbon steel, Carbon-¹/₂ Moly, and 1, 1¹/₄, and 2¹/₄ Chrome
 - Age: new to 48 years.
 - Diameter: 19.7 to 32 feet.
 - Tangent-to-tangent length: 50.5 to 102 feet.
 - Minimum shell thickness: 0.45 to 1.54 inches.
 - Maximum shell thickness: 0.84 to 1.89 inches.
- Laser scans originally used for assessing bulging severity using the Plastic Strain Index (PSI)TM.



Bulging Types

- Uniform
 - Seam Bulging
 - Bottom Growth
 - Tapered Growth
 - Outage Growth
 - Mid-height Growth
 - Band Bulging
 - Helical Bulging
 - Accordion Bulging
- Local



Weil and Rapasky (1958) The constrained balloon



Classical Seam Bulging





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Bottom Growth



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Tapered Growth









Mid-height Growth



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Band Bulging



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HOUSTON Engineering solutions





Accordion Bulging



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Local Bulges



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- Fabrication / design:
 - Local PWHT
 - Material / section mismatch
- Operation:
 - Coke stiffness
 - Thermal Gradients:
 - Axial
 - Circumferential
 - Local



Recap

- Bulges are not all the same
- Examined large database of laser scans
- Introduced distinct types of bulges
- Examined underlying causes rooted in design, fabrication, and operation

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